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ABSTRACT

Using an approach to classroom research that D. Newman (1990) has termed a formative experiment, a study investigated the effects of engaging elementary school students in creating computer-based multimedia reviews of books they read independently. Formative experiments are designed to investigate how an instructional intervention can be implemented to achieve a pedagogical goal in a particular educational environment. Creating multimedia book reviews was the intervention; increasing the amount and diversity of students' independent reading was the pedagogical goal. Diverse quantitative and qualitative data were gathered during 2 academic years in 9 4th-grade and 5th-grade classrooms across 3 schools. Consistent with the intent of formative experiments, results are presented guided by the following questions: (1) What factors in the educational environment enhance or inhibit the intervention's effectiveness in achieving the pedagogical goal?; (2) How can the intervention and its implementation be modified during the experiment to achieve more effectively the pedagogical goal?; (3) What unanticipated positive or negative effects does the intervention produce?; and (4) Has the educational environment changed as a result of the intervention? Results indicated that the multimedia book review activity contributed to achieving the pedagogical goal of increasing the amount of children's independent reading; and school environments and teachers' roles to some extent shaped the effects of the activity. Findings suggest that formative experiments can address the limitations of conventional research methods previously used to study computer-based literacy activities in classrooms. (Contains 64 references, and 4 tables and 11 figures of data. Appendixes presents parent and teacher questionnaires.) (Author/RS)

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A Formative Experiment Investigating the Use of Multimedia Book Reviews to increase Elementary Students' Independent Reading

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NRRC National Reading Research Center

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READING RESEARCH REPORT NO. 55
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The work reported herein is a National Reading Research Project of the University of Georgia and University of Maryland. It was supported under the Educational Research and Development Centers Program (PR/AWARD NO. 117A20007) as administered by the Office of Educational Research and Improvement, U.S. Department of Education. The findings and opinions expressed here do not necessarily reflect the position or policies of the National Reading Research Center, the Office of Educational Research and Improvement, or the U.S. Department of Education.

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The National Reading Research Center (NRRC) is funded by the Office of Educational Research and Improvement of the U.S. Department of Education to conduct research on reading and reading instruction. The NRRC is operated by a consortium of the University of Georgia and the University of Maryland College Park in collaboration with researchers at several institutions nationwide.

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A Formative Experiment Investigating the Use of Multimedia Book Reviews to Increase Elementary Students' Independent Reading

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Abstract. *Using an approach to classroom research that Newman (1990) has termed a formative experiment, this study investigated the effects of engaging elementary school students in creating computer-based multimedia reviews of books they read independently. Formative experiments are designed to investigate how an instructional intervention can be implemented to achieve a valued pedagogical goal in a particular educational environment. In the present study, creating multimedia book reviews was the intervention; increasing the amount and diversity of students' independent reading was the pedagogical goal. Diverse quantitative and qualitative data were gathered during 2 academic years in 9 fourth- and fifth grade classrooms across 3 schools. Consistent with the intent of formative experiments, the authors present results guided by the following questions: (a) What factors in the educational environment enhance or inhibit the intervention's effectiveness in achieving the pedagogical goal?; (b) How can the intervention and its implementation be modified during the experiment to achieve more effectively the pedagogical goal?; (c) What unanticipated positive or negative effects does the intervention produce?; and (d) Has the educational environment changed as a result of the intervention? In addition to describing the study and reporting results, the authors discuss emerging understandings of formative experiments. They argue that formative experiments can address the limitations of conventional research methods previously used to study computer-based literacy activities in classrooms.*

Diverse approaches to research have been used to study whether computer-based instructional activities can enhance literacy in classrooms. However, most studies have used conventional experimental designs aimed at comparing the effectiveness of interventions with and without computer-based activities (cf. Means et al., 1993; Reinking & Pickle, 1993). Despite the prevalence of experimental studies, reviews of classroom research (e.g., Reinking & Bridwell-Bowles, 1991) as well as the observations and findings of some researchers (Bruce & Rubin, 1993; Dickinson, 1986; Mehan, 1989; Michaels & Bruce, 1989; Reinking & Pickle, 1993; Rubin & Bruce, 1990) suggest that conventional experiments alone do not provide adequate

information about how computer-based activities might effectively contribute to the acquisition of literacy in schools.

Conventional experiments do not adequately deal with the many interacting variables that influence the effectiveness of computer-based interventions in schools, nor do they typically deal with how a particular computer-based activity might produce unique effects depending on how it is integrated into a particular instructional environment. Instead, conventional experiments require researchers (a) to control the influence of most situational factors, (b) to implement a well-defined intervention that remains unchanged during the experiment, often in the face of changing conditions in the classroom, and (c) to focus primarily on post-intervention outcomes. These requirements may perpetuate a point of view that restricts the influence of technology in schools. As Emihovich and Wager (1992) state,

> . . . media are still perceived as add-ons to the educational process . . . [and] this perception will not change until educators begin to realize that media or technology use in schools should be examined from a holistic cultural perspective. That is, the introduction of any new technology should be considered in relation to its effect on the school culture as a whole, including the way students and teachers perceive the new technology, how administrators view it in relation to the organizational climate of the school, and the expectations parents and the broader community share concerning the effects of new technologies have, or should have, on learning. (pp. 435–36)

The limited scope of conventional experimental research involving computers in classrooms may explain in part why that research has not produced clear recommendations for educators interested in how technology might enhance literacy instruction in schools. Indeed, that research does not consistently support the use of computer-based activities over other interventions not using computers (Reinking & Bridwell-Bowles, 1991; Roblyer, Castine, & King, 1988). As Becker (1992) states in his review of the computer-based integrated learning systems,

> . . . the widely varying effects sizes and the modestly positive effect sizes that are typical suggest that . . . results differ as much based on the different conditions of the study as on the different software packages in use (and on the different methodologies used to design and conduct the analyses). (p. 38)

The relatively few qualitative and ethnographic studies investigating computers and literacy counter some of these limitations by focusing on the influence of situational factors over time within a particular classroom or school (Dickinson, 1986; Friedman, 1990; McGee, 1987; Mehan, 1989; Riel, 1989; Turner & Dipardo, 1992). However, such studies typically do not focus on the most instructionally relevant questions: What factors add to or detract from an intervention's success in accomplishing a pedagogically valued goal and, more importantly, how might the intervention be adapted in response to those factors?

To address the inherent limitations of conventional approaches to classroom research involving computer-based activities and to address these instructionally relevant questions, we adopted an approach to classroom research that Newman (1990) has termed a "formative experiment." Formative experiments, as we will describe more fully in a subsequent section, are aimed at investigating how instructional interventions can be adapted in response to factors that enhance or inhibit their effectiveness in achieving a valued pedagogical goal. And, they allow researchers to examine a broad range of interacting factors and events that influence an intervention's effectiveness as well as its unanticipated consequences. The instructional intervention reported here involved fourth- and fifth-grade students and their teachers in creating multimedia book reviews related to their independent reading as an alternative to the conventional required book report. That is, we were interested in systematically examining how we might engage elementary school students and their teachers in creating multimedia book reviews with the goal of increasing the amount and diversity of students' independent reading. Our study encompassed seven classrooms in three schools during two academic years.

Formative experiments are especially applicable to conducting classroom research aimed at investigating computer-based interventions (Newman, 1990) because the expected advantages of such interventions have been difficult to achieve. On one hand, it is clear that much of the interest in educational uses of computers is related to the belief that they have strong potential to transform positively the standard modes of teaching and learning in schools (e.g., Newman, 1990; Papert, 1993; Sheingold, 1991). On the other hand, it is clear from a variety of sources that simply introducing innovative, powerful, computer-based activities into a classroom is typically not enough to achieve this potential (Means et al., 1993). Empirical studies of how computers are used in schools support this conclusion. Such studies have documented consistently that the number of computers for instruction in schools has increased geometrically since the early 1980s, but the amount of time they are used and their level of integration into the curriculum has not kept pace with availability (c.f., Becker, 1990, 1992a; Congressional Office of Technology Assessment, 1988; Martinez & Mead, 1988). These findings reflect what many writers argue is an inordinate concern for acquiring technology without concomitant attention to establishing clear pedagogical goals that it's acquisition will promote (see Reeves, 1992). Even when schools and teachers attempt to integrate computers into instruction to achieve clearly defined goals, they often face many obstacles (Gustafson, 1993; Hadley & Sheingold, 1993). These obstacles may be technological, logistical, curricular, financial, interpersonal, and so forth.

Consequently, there has been an increasingly clear realization based on research and supported by the experiences of many educators in schools that simply placing computers into a school or classroom rarely produces notable changes in teaching and learning

(see Miller & Olson, 1994). As Bressler and Walker (1991) state, "Even when an innovation meets people's expressed needs, it may still not succeed unless it fits the patterns by which they run their lives as students and teachers" (p. 66). Yet, many writers and educators remain steadfast in their belief that computers have strong potential to do so.

Even when computer-based activities are specifically designed to transform or reorient teaching and learning, they may be implemented in such a way as to maintain the status quo. A well-documented example is the work of Bruce and his colleagues (Bruce & Peyton, 1990; Bruce & Rubin, 1993; Michaels & Bruce, 1989) who have conducted extensive investigations of a computer-based intervention called QUILL. QUILL is a comprehensive computer-based tool to support writing and reading. It is comprised of distinct components such as the "mailbag" (to facilitate on-line communication among students and teachers), the "planner" (for getting ideas for writing and for organizing ideas respective to various genres), the "library" (a textual information base created by and shared among students and teachers), and the "writers assistant" (a word processing program designed to be compatible with the other components).

Bruce and his colleagues developed QUILL specifically to promote valued pedagogical goals in literacy such as critical thinking, integration of reading and writing, meaningful communication, collaboration, and revision. QUILL was also developed to be open ended with the intent that it would be used differently in each situation. For example, some teachers and students might use it to develop a classroom newspaper while others might focus on writing about academic topics. In short, Bruce and his colleagues designed QUILL to effect changes in the way reading and writing were typically carried out in individual classrooms. As Michaels and Bruce (1989) state, they hoped that it "would alter the writing systems, and hence students' access to writing and reading opportunities" (p. 12). However, they found that "rather than the new technology radically reshaping the learning environment, the computers themselves were shaped to fit the already established patterns of social organization" (p. 12). Based on their analysis of QUILL in two classrooms over two years they concluded that:

> . . . it becomes clear that no innovation, no matter how well conceived, and no application of innovation, no matter how well intended and executed, can in and of themselves be assured of achieving positive change in instruction. Instead, one must continually reexamine what is happening and ask critical questions: What is the innovation we are using? What are the different ways that students are engaged in learning? What is the effect of my actions on students' learning? What are the goals of instruction, of each activity? And so on. (Michaels & Bruce, 1989, p. 35)

In a similar vein, Bruce and Rubin (1993) state that their "detailed, self-critical ap-

perusal of the evidence [about QUILL] yields surprises and reveals a richness in what students and teachers do that belies both optimistic and pessimistic visions of technology in relation to educational change" (p. 1). Our decision to use a formative experiment as an approach to research in the present study was based on our concurrence with their position and with the position of researchers who have discussed the limitations of conventional experiments in conducting classroom research (e.g., Reinking & Pickle, 1993).

Formative Experiments

Dissatisfaction with conventional experiments as an approach to classroom research as expressed by many writers interested in technology (e.g., Bruce & Rubin 1993; Newman, 1990; Papert, 1987; Reinking & Bridwell-Bowles, 1991; Reinking & Pickle, 1993; Vygotsky, 1983) reflects the broader concern that researchers must seek out alternative approaches to research that address the complexity of classrooms (see Eisenhart & Borko, 1993; Jackson, 1990). The concept of a formative experiment as described by Newman (1990) is one proposed alternative to conventional experiments.

However, it is important to note that the concept of a formative experiment is evolving. This characterization is evidenced first by the fact that there are few published sources of information discussing explicitly the concept of a formative experiment (to our knowledge limited to Newman's 1990 article in the *Educational Researcher* and our own published work based on our experiences in the present study; see Reinking & Pickle, 1993; Baumann, Jones, Shockley, Abbermann, & Reinking, 1994). Second, the concept of a formative experiment is not yet clearly distinguishable from related concepts such as "situated evaluation" (Bruce & Rubin, 1993), "design experiments" (Brown, 1992), "formative evaluation" (see Flagg, 1990), and "*rapid prototyping*" (Tripp & Bichelmeyer, 1990). While supporting the fact that classroom research is evolving, Eisenhart and Borko (1993) state that

> the standards for using . . . alternative methodologies in educational research are not understood in the same way they are for established methodologies; thus their use demands more thought and explanation than might be necessary if conventional procedures were used. (p. 11)

To address this issue, we provide here an overview of our evolving understanding of formative experiments based on Newman's (1990) description and our own experience in the present research project. Thus, the present report has a dual purpose. Foremost, it provides a description of a computer-based intervention and how it was implemented to accomplish the goal of increasing the amount and diversity of students' independent reading. However, it also reports our expanded understanding of formative experiments and their potential to contribute to literacy research.

Newman (1990) has described a formative experiment as follows: "In a formative experiment, the researcher sets a pedagogical goal and finds out what it takes in terms of materials,

Correlational Experiments	Qualitative or Ethnographic Studies	Formative Experiments
How does the use of multimedia book reviews compare to some other classroom activity aimed at increasing independent reading?	In a classroom using multimedia book reviews (perhaps when compared to classrooms using alternative activities), what are the dominant factors that explain why some students read more and some read less?	Given a pedagogical rationale for believing that multimedia book reviews have potential to meet the goal of increasing independent reading, how must this activity be implemented in a particular classroom to achieve its stated goal?

Figure 1. Matching related research questions and approaches to research.

organization, or changes in . . . technology to reach the goal" (p. 10). Thus, formative experiments address a different category of questions when compared to conventional experiments or qualitative approaches to research. Figure 1 compares how three approaches to research can be matched to three related but different research questions that might guide an investigation of multimedia book reviews as a classroom intervention.

Drawing on Newman's (1990) explication of formative experiments and our own experience in conducting the present investigation, we have proposed six questions as a framework for designing and conducting formative experiments (see Baumann et al., 1996):

1. What is the pedagogical goal of the experiment and what pedagogical theory establishes its value?

2. What is an instructional intervention that has potential to achieve the identified pedagogical goal?

3. As the intervention is implemented, what factors enhance or inhibit its effectiveness in achieving the pedagogical goal?

4. How can the intervention and its implementation be modified to achieve more effectively the pedagogical goal?

5. What unanticipated positive or negative effects does the intervention produce?

6. Has the instructional environment changed as a result of the intervention?

These questions serve as a guide for reporting our investigation. Questions 1 and 2 are related and are analogous to the rationale for the experiment and the literature review included in conventional research reports. These questions will be addressed in the next two sections of this report. Questions 3-6 involve the collection of baseline data prior to implementing the intervention and the collection of on-going data during the intervention.

issues pertaining to data collection and analysis in a formative experiment will be addressed specifically in a subsequent section and as we present our methods and findings. As in a conventional research report, we conclude with a summary and general discussion of our findings.

Our Pedagogical Goal and Its Value

Our pedagogical goal in this formative experiment was to increase the amount and diversity of students' independent reading. In addition to being a longstanding, widely accepted, and intuitively valued instructional goal in reading instruction, research has reinforced the centrality of independent reading as a powerful means to increase students' reading competency. Theorists and reviewers of existing research such as Stanovich (1986) have argued that differences in reading ability are due in large measure to differences in the amount of children's reading. And, studies involving large samples of students nationally indicate a strong positive correlation between reading out of school and reading achievement (see Foertsch, 1992). Similarly, there is evidence that valued correlates of reading ability such as vocabulary knowledge are also related to how much children read (see Freebody & Anderson, 1983). In addition, independent reading is a defining attribute of engaged reading, which has been identified as a dominant theme of the National Reading Research Center (see Alvermann & Guthrie, 1993). Increasing children's interest in reading independently has also been identified as having the highest priority for research among teachers and school administrators (see O'Flahavan et al., 1992).

Despite the substantiated view that the amount of students' independent reading figures highly in their reading ability and their propensity to read, there is strong evidence that many children engage in independent reading infrequently, especially outside of school. For example, Anderson, Wilson, and Fielding (1988) found that reading ranked well behind other outside-school activities such as watching television and talking on the telephone. A comparison of two administrations of the National Assessment of Educational Progress (NAEP) in 1988 and 1990 (see Foertsch, 1992) suggests that there may be a trend toward further decreases in the amount of students' independent reading. For example, that comparison found decreases in library use and in reading for fun, which was accompanied by an increase in the percentage of students reporting that they read only fiction or only nonfiction. Likewise, approximately half of the students in the eighth grade (no data were available for the fourth-grade students) reported reading the same author either weekly or monthly, which perhaps indicates a lack of diversity in their reading.

Thus, the value of setting a pedagogical goal to increase the amount and diversity of students' independent reading is justified because (a) research indicates that independent reading plays a central role in determining reading ability, (b) evidence suggests that many children do relatively little independent reading, especially outside of school, and that there is a trend toward further decreases in the amount and diversity of independent reading.

and (c) surveys of educators identify increasing interest in reading as a priority for reading research.

The Instructional Intervention

The instructional intervention in a formative experiment may be one found in the existing literature, selected primarily to test its relation to a pedagogical theory, or one the investigator designs specifically to address the pedagogical goal, thus testing an alternative means to accomplish the goal (Baumann et al., 1996). The instructional intervention in the present experiment falls within the latter category. That is, the only previous literature related to having children create multimedia book reviews is our own work carried out within a conventional experimental paradigm (see Reinking & Pickle, 1993). In that work, we report only limited findings related to an intervention that used computers but did not employ multimedia. In the remainder of this section, we elaborate our rationale for designing the instructional intervention and we provide an overview of its components as they evolved during the 2 years of implementation in three elementary schools.

Rationale for the Intervention

Our rationale for selecting multimedia book reviews[1] as an intervention to accomplish the goal of increasing the amount and diversity of reading was based primarily on its potential as an alternative to the conventional required book report. In the middle grades, the required book report is a ubiquitous instructional activity aimed at encouraging students' independent reading. Despite its widespread use, many authors have questioned its effectiveness in accomplishing that goal. Although no empirical evidence can be cited, writers such as Spiegel (1981) have argued that the required book report may actually subvert teachers' intentions by encouraging some students to read less (by selecting shorter books) and more narrowly (by avoiding genres or topics that may prove unappealing). Likewise, the required book report is frequently cited by our undergraduate and graduate students as one of the most negative memories of elementary school reading instruction. In contrast, the opportunity to work on a computer has been consistently identified as a highly motivating instructional activity in schools (Becker, 1990; Reinking & Bridwell-Bowles, 1991).

Although there are many classroom activities to encourage independent reading and authentic responses to books, there is no evidence that such activities have replaced the wide spread use of conventional book reports. We reasoned that using technology to transform an activity familiar to both students and teachers had an advantage over other alternatives not so firmly entrenched in the dominant instructional culture of elementary schools. That is, multimedia book reviews are concep-

[1] *We purposefully used the term book review instead of book report when discussing this intervention among ourselves and among the teachers and students with whom we worked. This decision was based on our desire to highlight the differences we perceived between the purposes of the conventional book report and the multimedia activities with which we wished to engage teachers and students.*

tually similar to book reports and therefore are not radically different from a familiar school activity. This familiarity might enhance the potential for integration into existing instructional activities, while at the same time the unique characteristics of multimedia book reviews might counter some of the negative aspects of conventional book reports. This perspective is consistent with one of five questions addressed by formative experiments as an approach to classroom research. That is, formative experiments address whether an intervention has been fully appropriated by teachers and students (see Newman, 1990) or the degree to which the educational environment has changed as the result of the intervention (see question 6 in the framework for designing a formative experiment presented in a previous section).

The required book report can also be criticized because as typically implemented in classrooms it is inconsistent with the meaningful communicative activities that have been shown to enhance students' reading and writing. For example, Kirby and Kirby (1985) in their analysis of the research on assigned school-related and unassigned out-of-school tasks concluded that students who complete assigned school tasks take fewer risks in reading and writing. As typically implemented in many classrooms, students write book reports primarily for the teacher in order to satisfy a requirement or to obtain extra credit. One of the advantages of computer technology that has been frequently cited in the literature is its potential to create opportunities for students to engage in meaningful communicative experiences that frequently involve reading and writing (e.g., Bruce & Rubin, 1993; Means et al., 1993; Reinking, 1988). There is also some evidence that engaging students in creating multimedia activities can imbue school reading and writing activities with the characteristics of out-of-school reading and writing. For example, Turner and Dipinto (1992) concluded in their qualitative study of students who became hypermedia authors that,

> Their strong sense of audience motivated the students to present the information so that their peers could understand it better. Technology didn't just enhance the appearance of students' reports, it also encouraged them to rethink how to present information to communicate it more effectively. (p. 148)

Extrinsic awards are also often associated with conventional book report activities. For example, a popular restaurant chain provides free pizzas for students who can document independent reading of books, and many schools participate in such programs. Similarly, a popular commercial computer program awards points based on the difficulty and length of various books when students can pass an on-line test of factual information in the books. Teachers will frequently use the points as a basis for distributing prizes for reading independently. Our pedagogical theory devalues these approaches in favor of more intrinsically motivating activities, a point of view substantiated in part by consistent findings that tangible rewards simply for completing tasks has a somewhat negative effect on intrinsic motivation (see Cameron & Pierce, 1994).

Figure 2. Comic strip representation of a potential limitation of multimedia book reviews.

Thus, there is reason to believe that multimedia book reviews, as an alternative to conventional required book reports, have potential for increasing the amount and diversity of students' independent reading by engaging them in personally meaningful responses to what they read, by sharing those responses through their multimedia presentations, and by capitalizing on the intrinsic motivation of using a computer to share information about what one has been reading.

At the same time, we recognized a priori that there may be potential problems associated with multimedia book reviews, which may undermine their effectiveness in accomplishing the pedagogical goal. For example, one potential problem is that students might have more interest in creating multimedia products than in reading books, and thus the intervention may actually interfere with students propensity to read. This limitation is reflected poignantly in a recent comic strip presented in Figure 2. As this concern illustrates, formative experiments, unlike conventional experiments, encourage researchers to acknowledge that virtually all instructional interventions entail some potentially negative instructional by-products. However, formative experiments are designed to *identify* specifically what factors inhibit the accomplishment of the pedagogical goal and to *adapt* the intervention or its implementation to address those factors that have a negative effect on achieving the pedagogical goal.

Overview of the Intervention and Computer Programs

In a formative experiment the intervention and the way it is implemented may change as parties involved in the research respond to ongoing data collection aimed at determining the factors that enhance or inhibit the accomplishment of the pedagogical goal. Nonetheless, it is possible to describe the intervention in general terms, at least as it is initially conceived prior to the experiment. In the present experiment, our initial broad conception of the intervention remained intact throughout the 2 years we worked in three elementary schools, although, many details related to its implementation evolved and were adapted in response to our on-going data collection and analysis. Here we provide an overview of the intervention and describe the most recent version of the computer programs in use at the completion of the experiment.

As we have indicated previously in this report, we conceptualized multimedia book reviews as an alternative to conventional book reports. Like a conventional book report, a multimedia book review was to be completed by students independently after they read a book. Unlike a conventional book report, multimedia book reviews were to be created with the aid of a computer that allowed graphics and sound to accompany textual information. Another key difference was our intention that the multimedia book reviews would be compiled into a searchable database available for use by students, teachers, parents, and other interested individuals. We envisioned that this database of students' multimedia book

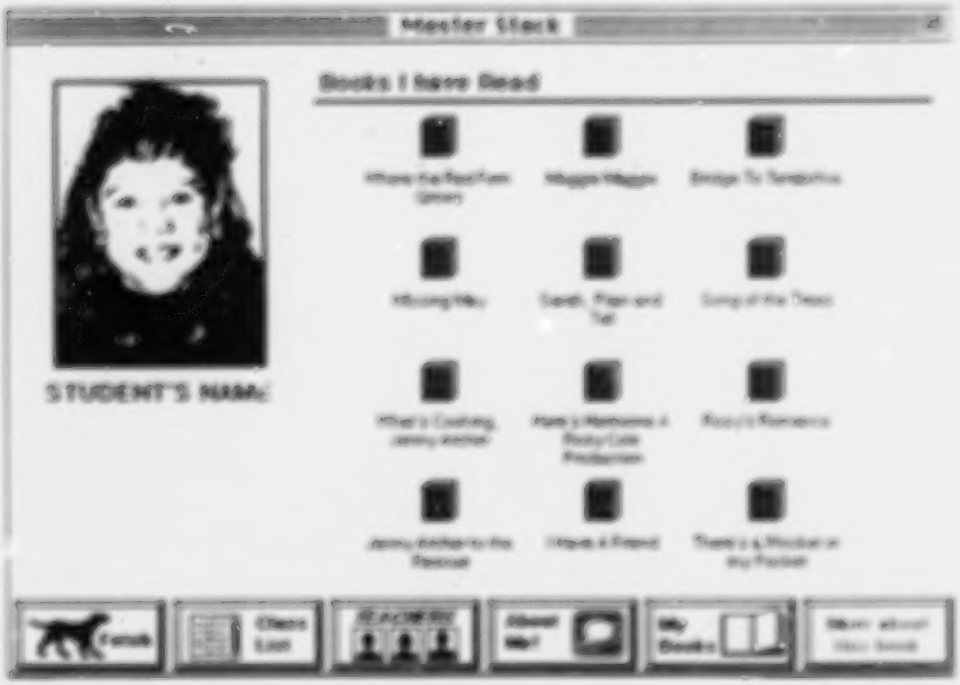

Figure 3. Template card 1: Main menu screen showing the books a student has read and reviewed.

reviews would be available in an easily accessible location such as a school's media center. As discussed previously, we reasoned that the use of the computer to create multimedia products had potential to increase students' motivation and engagement when compared to conventional book reports.

Likewise, we reasoned that the database was an important extension of the conventional book report. The audience for conventional book reports is typically the teacher, and book reports are usually completed as a required school-related task. However, given the purpose of the database, the audience for multimedia book reviews would be much broader, and the purpose would be more functional and therefore authentic. In addition, the database would provide an appealing mechanism for students to explore each others' reading and to find books they might like to read. Similarly, although each multimedia book review would be an individual student's product, we envisioned much collaborative work among students as they assisted each other in dealing

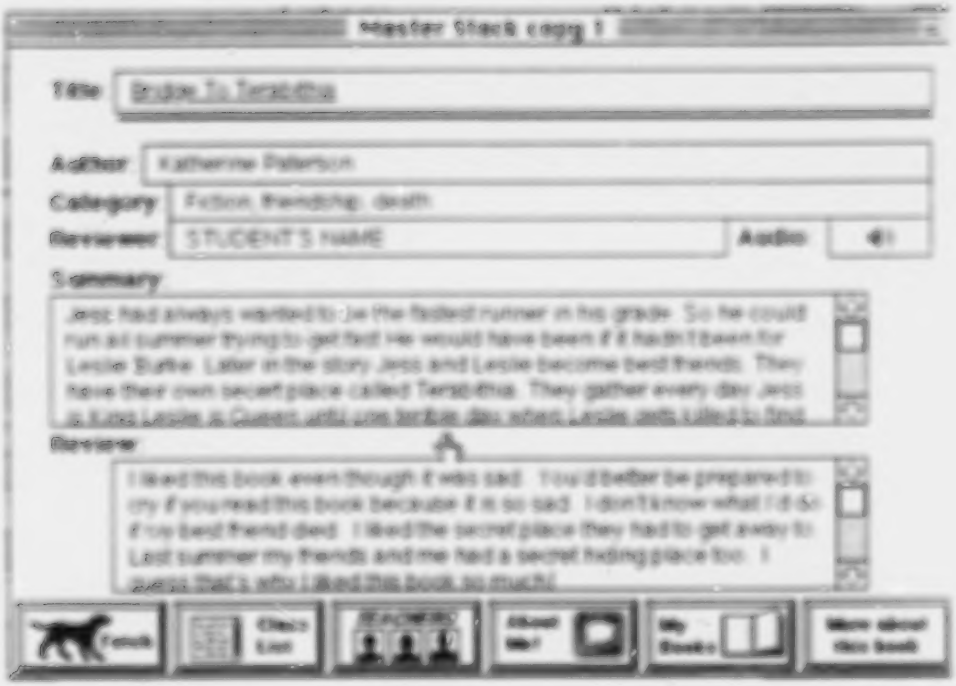
Master Stack copy 1
Title
Bridge To Terabithia
Author
Katherine Paterson
Category
Fiction: friendship: death
Reviewer
STUDENT'S NAME
Audio
Summary
Jess had always wanted to be the fastest runner in his grade. So he could
run all summer trying to get fast He would have been if it hadn't been for
Leslie Burke. Later in the story Jess and Leslie become best friends. They
have their own secret place called Terabithia. They gather every day Jess
is King Leslie is Queen until one terrible day when Leslie gets killed by a
Review
I liked this book even though it was sad. You'd better be prepared to
cry if you read this book because it is so sad. I don't know what I'd do
if my best friend died. I liked the secret place they had to get away to.
Last summer my friends and me had a secret hiding place too. I
guess that's why I liked this book so much!
Class List
Readers
About Me?
My Books
More about this book

Figure 6. Template card 2: Review screen completed by students for each book reviewed.

with the new technological skills needed to create multimedia book reviews. Taken together, we believed that these differences between conventional book reports and multimedia book reviews had potential to transform a common school activity in a way that would have a positive affect on the amount and diversity of their independent reading.

To provide students and teachers with much flexibility in creating multimedia book reviews and to increase their involvement in this alternative (as well as its potential to be appropriated fully into the instructional environment), we decided to teach teachers and students how to use HyperCard (Version 2.1). HyperCard is an authoring system for the Macintosh computer, and it can be used to create multimedia presentations. It is a powerful, open-ended application for creating computer programs, but it permits a user to create relatively sophisticated computer applications with only basic knowledge of its operation. We planned to acquaint teachers and students with the rudimentary tools necessary to create

Figure 5. A student's drawing (using clip art and drawing tools) from the "More about this book" option on the review card (see Figure 4).

HyperCard programs referred to as "stacks," which is an extension of the HyperCard metaphor of screens as "cards" that are linked by clicking on "buttons." We taught them how to use all of the basic HyperCard tools short of scripting, which is a more advanced level of HyperCard programming.

One dilemma that we faced early in our planning and implementation of the intervention was how to design the multimedia book reviews to be open-ended and personal while accommodating the standardization necessary for the database to be searched systematically. In other words, the database of multimedia book reviews that we envisioned required that information be embedded into established categories. However, if we required students to enter information about the books they read into predetermined categories, we might subvert their creativity and their personal responses to creating each book review.

Our successive attempts during the experiment to resolve this dilemma and to notice what effects it had on students and teachers is one example of why this approach to research is described as formative. That is, the solution to our dilemma emerged through a series of adaptations and compromises in response to what we observed during the experiment. Some of these adaptations include: (1) seeking teachers' and students' input into what categories of information about the books they read that they thought most relevant; (2) seeking their input about the layout of these categories on a standard card used by all students, which came to be referred to as the book review "template"; and (3) creating nonsearchable but personalized sections of the template (e.g., boxes for pictures and photographs, an audio button that played a student's comments about the book, and a card that provided an autobiographical sketch of each student reviewer). In addition, we eventually created a button that led to a separate nonsearchable stack that students could choose to create as their personal supplement to the basic template.

The most recent book review template, which is similar in many respects to earlier versions, is comprised of three screens ("cards" in HyperCard) presented in Figures 3, 4, and 6. The screen shown in Figure 3 is a

Master Stack copy 1
STUDENT'S NAME
Hi, my name is STUDENT'S NAME. I am in fifth grade at Borders school. My birthday is April 19, 1983. My favorite food is pizza with lots of cheeze. I like to play soccer and watch TV. My favorite show is Home Improvement. In 20 years I'll be a veterinian because I like animals so much. My favorite subject is social studies. I like learning about other countries. Maybe someday I'll fly all over the world. I'll like to read books that keep you interested especially about kids my age.
Fetch
Class List
TEACHERS
About Me!
My Books

Figure 6. Template card 3: Student-written biographical sketch.

template card 1 that serves as a main menu comprised of the student's picture and 12 icons representing the books that a student has read (additional screens can be added when a student has entered more than 12 books). A student's multimedia review of a particular book can be accessed by clicking on the appropriate book icon. Other components of the program can be accessed by clicking one of the buttons on the menu bar at the bottom of the screen. This menu bar appears at the bottom of all template cards and serves as the primary means for navigating among the book reviews and the database functions. The addition of this menu bar to earlier versions of the program illustrates the formative aspects of creating a computer application that operated efficiently within the larger goals of the experiment.

Template card 2, which serves as the main review screen, is shown in Figure 4. In addition to the menu bar, it is comprised of (a) textual fields into which students can enter descriptive information about the book as well as a summary and their comments about the book, (b) an

Fido Fetch 1.0
Fido Fetch!
Search for...
E. B. White
in:
Author
Title
Reviewer
Summary
Review
Category
About me!
Fetch Fido!
[Clicking the "Fetch Fido" button initiates a search through all of the students' book reviews for books authored by E. B. White, as specified in the search criteria above. The results of the search would be displayed in this box. The listing would include title, author, and reviewer for any review meeting the search criteria. A user can then click on any book listed to see how a student reviewed it.]
Fetch
About Me!
My Books

Figure 7. "Fido Fetch" screen used to direct the search of the data base containing all students' reviews.

audio button that plays students' comments or sound effects, and (c) and navigation buttons, including one ("more about this book") that allows students to add additional cards to their own specifications. For example, on these additional cards, many students chose to include pictures from clip art files, often modified or supplemented by their own art work created on-line with the drawing tools, and additional information about the book's authors or characters (see Figure 5). The textual fields are scrolling fields so that a student has unlimited space to enter text despite the small area displayed initially on this screen. All of the textual fields can be searched when using the database application described momentarily.

Figure 6 shows the third template card, which is the screen that students used to enter biographical information. Their bio-

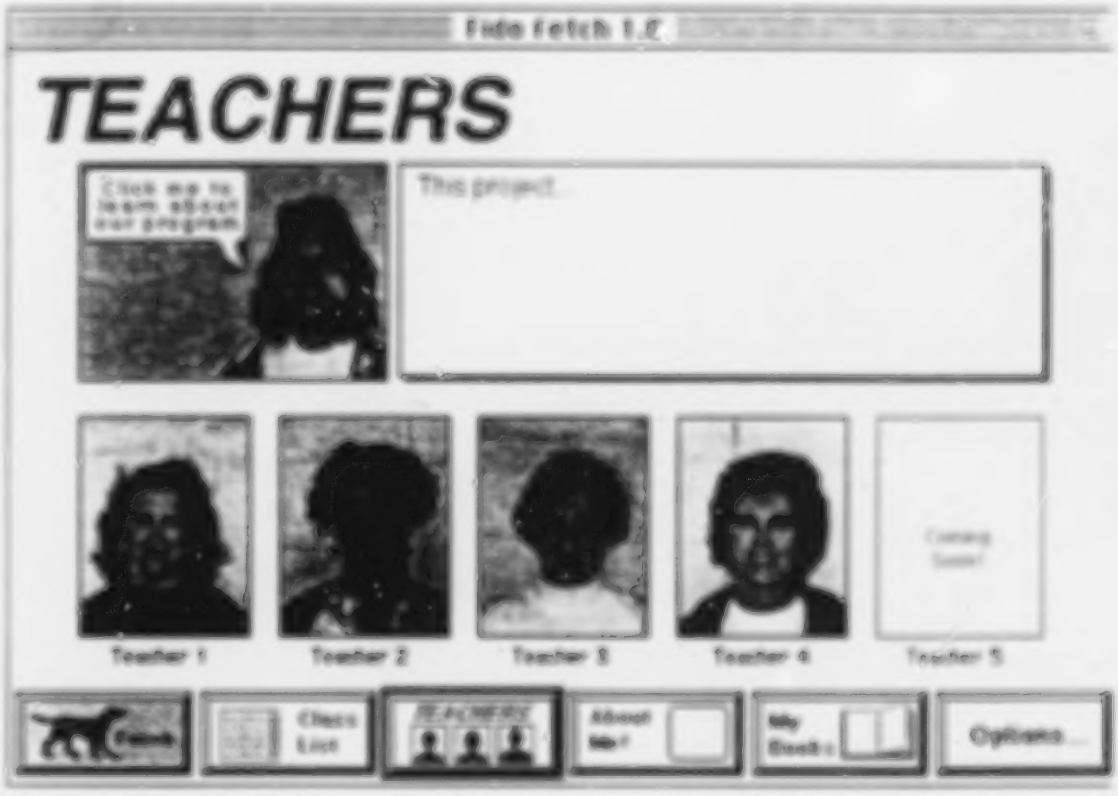

Figure 9. Screen showing teachers whose students' reviews can be accessed by clicking on a teacher's picture.

graphical sketches can be accessed by clicking the button on the menu bar labeled "About Me!"

The *database* application, which we called "Fido Fetch," was operated from the card shown in Figure 7. To search the database, a user would select one of the categories to be searched, each category corresponding to the textual fields on the main review template (see Figure 4). After entering a key word or phrase in the textual field on the upper part of the screen and clicking on the fido fetch button, the database application would find all reviews containing the key word or phrase specified. These reviews would be displayed by title, author, and reviewer in the scrolling textual field on the lower part of the screen. Clicking on one of these reviews would display the full review.

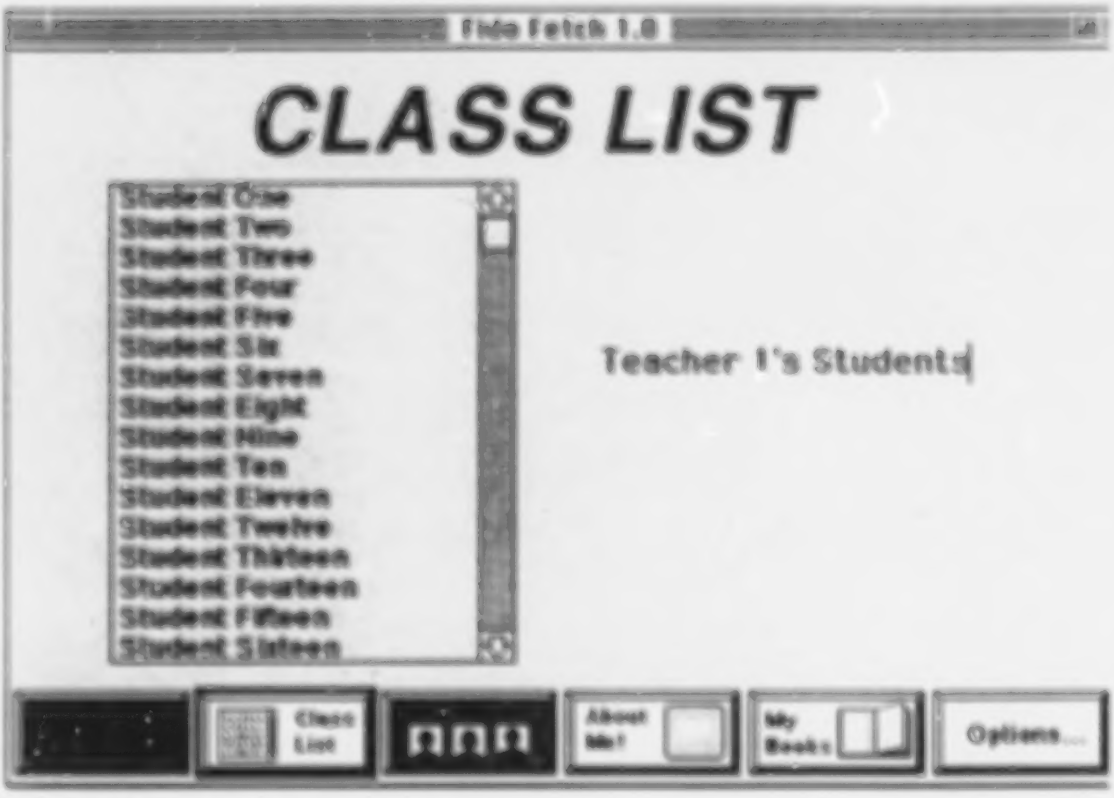

Figure 9. Screen showing students in a class whose reviews can be viewed by clicking on a student's name.

Initial entry into the reviews and the database application was achieved from the cards shown in Figures 8 and 9. The screen in Figure 8 displays pictures of teachers whose students have entered book reviews. A user could click on a teacher to access a list of students in that teacher's class (Figure 9) and then access a particular student's main book review menu (Figure 3) by clicking on the student's name in the list.

Method

Research Sites

This formative experiment was conducted in two elementary schools during the 1992-93 school year and in one elementary school during the 1993-94 school year. The schools were selected from among six schools contacted that had expressed an interest in the project and that had or were willing to purchase the mini-

and hardware needed to implement the intervention. The final selection of research sites was made by the university researchers based on the schools' location, equipment and facilities, enthusiasm for and commitment to the project, student populations, and so forth. Of the two schools that participated during the 1992–93 school year, one school (hereafter referred to with the pseudonym "Collins School") was located in a small town within commuting distance of a large metropolitan area. The school was relatively large, accommodating 3–4 classrooms of approximately 30 students at each grade level K–5. Students and teachers reflected the community's homogeneous population consisting of predominantly White, middle- and upper-middle-class families, many of whom commuted to work in the nearby large metropolitan area. We worked with two fourth-grade classes and their teachers at Collins School. The second school (hereafter referred to with the pseudonym "Hartwig School") was located in a rural area, although its students came from blue-collar and professional homes in a small town as well as from agricultural areas. Approximately 15% of the Hartwig student population was African American. The school was moderately large, accommodating approximately 2–3 classrooms of 25–30 students at each grade level (K–5). We worked with 3 fifth-grade classes, their respective teachers, a Chapter 1 teacher, and a gifted teacher in Hartwig School. The third school (hereafter referred to with the pseudonym "Borders School") was in the same school district as Hartwig School and had a similar, although somewhat smaller, student population. At Borders School, we worked with 1 fifth-grade and 1 fourth-grade class, their respective teachers, and a Chapter 1 teacher who also managed the computer lab.

Hartwig and Borders schools each had a small computer lab with 12 and 10 Macintosh LC II computers, respectively. Both schools had access to a color scanner for digitizing pictures and several printers. Borders school also had a black and white LCD panel for displaying Macintosh output on a standard overhead projector. In comparing the implementation of the intervention at the three schools, we found that the LCD panel was an invaluable tool in teaching students HyperCard. It greatly streamlined that phase of implementing the intervention. Collins school had a computer lab of Apple IIe computers, but purchased two Macintosh LC II computers and a scanner to be shared by two classes involved in the experiment. During the first year of the project, we were interested in discovering the logistical and pedagogical implications of implementing the intervention in a lab setting where students worked for approximately 1–2 hr per week in the computer lab when compared to a setting in which a single computer was available constantly in a classroom. Based on our experiences, these two alternatives represent typical patterns of availability in elementary schools (see also Becker, 1990, 1992a, 1992b). Likewise, our goal at Collins School was to minimize the amount of knowledge students would need about HyperCard in order to enter their book reviews, relying instead on training teachers and parent volunteers to assist with HyperCard applications developed by the university researchers.

Participants

The composition of the university research team varied during the course of the project, but included the principal investigator (the first author of this report), three consultants, and five doctoral students who provided assistance at various stages of the project in areas such as solving technological difficulties, collecting and analyzing data, teaching HyperCard to teachers and students, and writing the final report. The three consultants included Thomas Reeves, a Professor of Instructional Technology at the University of Georgia (UGA); Mary Jo Brown, an Assistant Professor at UGA who teaches courses in qualitative research; and Valerie Garfield, a middle-grades teacher who has had much successful experience in integrating computers into her teaching. Although we are indebted to them for their input and assistance, this report reflects only our own summary and interpretations.

Consistent with the goals of the National Reading Research Center (see Alvermann & Guthrie, 1993) and the nature of formative experiments, we considered the classroom teachers with whom we worked on this project to be integral members of our research team. We continually sought their interpretations of what was occurring in their classrooms relative to the experiment, and we continually solicited their suggestions for modifying the intervention. Members of the university research team met regularly with the teachers to discuss their observations of what was occurring and to plan future strategies and modifications. Teachers also kept written logs of their observations, which were discussed periodically with a university researcher. In addition, teachers with whom we worked were co-authors on papers presented at two national professional meetings and the teachers participating in the project at Borders school appeared without the university researchers on the program of a state professional meeting where they made a presentation related to their involvement in the project.

Nonetheless, it may not be accurate to consider the present formative experiment as an example of collaborative research given current definitions (cf. Allen, Buchanan, Edelsky, & Norton, 1992; Anders, 1996; Jervis, Carr, Lockhart, & Rogers, 1996). We did not involve the teachers in selecting the pedagogical goal (although they clearly agreed that it was an important one), nor did we formally involve them in analyzing data. Neither did we involve them directly in preparing this report. Also, we observed and analyzed teachers' reactions and behaviors during the time we were working in the schools as part of the experiment without systematically sharing our conclusions with them until after the experiment. Thus, in this report we use pseudonyms to refer to the teachers with whom we worked closely.

We wish to note that our decision to not involve teachers fully as equal partners in the research process was not based on our disagreement with the more stringent standards outlined in the emerging literature on collaborative research. Our stance in this project was consistent with that literature, which suggests that truly collaborative research in which teachers define themselves as researchers tends to evolve over an extended time and across a number of collaborative experiences. Given the

separate professional cultures of researchers and teachers that is prevalent today, it may not be possible to generate the trust, confidence, and understanding necessary for a true collaboration without an extended period of interaction (see Anders, 1996; Jervis et al., 1996). As we write this report, further collaborations between some of the teachers and the university researchers are being planned. We are confident that these future collaborations will move increasingly towards the ideal of truly collaborative research and that the teachers involved will increasingly define themselves as researchers.

In general, the participants in this experiment did not deviate in significant ways from the researchers, teachers, and students one would expect to find in their respective environments. The researchers from the university had the orientations and values one would expect of other doctoral students and faculty in a major research-oriented university, albeit we believe with a heightened awareness of collaborative research and of the value of teachers as professional colleagues. From the outset of this project, we also were excited about the potential of formative experiments as a new approach to classroom intervention research, and we were eager to explore the new insights it might produce about computer technology and literacy and about our own understandings of research.

In general, the schools and classrooms in this investigation reflect the organization and operation typical of many elementary schools serving the community populations described previously. Classrooms were self-contained for most of the day, although students did occasionally receive instruction from other teachers who taught subjects such as Art, Physical Education, and Band, and these times often provided an opportunity for teachers to have a planning period. A relatively small percentage of the students in each classroom left periodically for special instruction in the Chapter 1 or gifted programs. A commercial basal reading series figured prominently in reading instruction. Although two of the teachers in Collins school described themselves as having a whole language orientation, we did not observe their practices to deviate greatly from the other teachers who used basals extensively. Prior to their involvement in this experiment, all of the teachers devoted some time to classroom activities aimed at encouraging independent reading. Such activities included requiring students to write conventional book reports, reading sections of books that they thought students might want to read, and putting up bulletin boards showing the number of books read by each student in the class. For the most part, the teachers made available books for independent reading through a classroom library rather than through regular trips to the school library.

As determined through a structured interview (see Appendix A), all of the teachers had some background with computers in their teaching, although the amount and type of that experience varied somewhat. Through observing their classrooms and daily routines during a baseline period before the multimedia book review activity was introduced, we found that all of the teachers were actively using the computer in conjunction with their teaching activities, but they did so in ways that were

May	June–August	Sept.–mid Oct.	Oct.–January	February–May	May
Phase 1 Preliminary meetings	*Phase 2* Teacher and support staff training	*Phase 3* Gather baseline data	*Phase 4* Teach students HyperCard and develop templates	*Phases 5 and 6* Students create multimedia book reviews and enter them into database	*Phase 7* Gather postexperience data

Figure 10. Phases of the experiment and approximate time line of events.

largely perfunctory and not fully integrated into their instructional program. For example, the following comment by one of the teachers was typical.

> I use it [the computer] mostly for when they finish their work and enrichment type [activities]. The games that were on [the computer] were just to reinforce skills. But not everyone had access to it because there were always the ones who never go to it.

The teachers were all enthusiastic about discovering more ways to use the computer in their instruction, which was one of our criterion for choosing to work with them in this project; however, they all acknowledged some degree of trepidation about technology, which they felt was typical of but not as extreme as their peers. For example, in an interview one teacher stated,

> We had a workshop this summer on using the computer as an instructional tool. For anyone who wanted to sign up. . . . They did a survey, and there was a big majority that was terrified. They had no experience, they didn't even want to touch it. But after the workshop, our staff has [begun] to feel like its not going to bite if they touch it.

Beyond these similarities, there were clearly important individual differences among teachers, students, and classrooms relevant for this study, but these differences will be highlighted subsequently in our presentation of findings and interpretations.

Procedures

The research project proceeded through several phases during the first year in Collins and Hartwig Schools, and these phases were repeated with minor variations during the second year in Borders School. The phases of the project and the events associated with each phase are described in this section and are summarized in Figure 10.

Phase 1. Phase 1 took place in the spring prior to the school year during which the intervention was to be implemented. At that

time, representatives of the university research team met with teachers, the school principal, and in some cases district office personnel to discuss the project, what expectations there would be for the various participants, needed hardware, and so forth.

Phase 2. When expectations were clearly understood and supported by all participants, we proceeded to Phase 2, which took place during the summer. During several summer meetings, members of the university research team trained teachers and in some instances parent volunteers and teacher aids to use the Macintosh LC II computer as well as the basic tools and operations of HyperCard. We also discussed with the teachers our conceptions of the multimedia book reviews, how we thought they might be implemented, the nature of formative experiments, logistical problems, data collection, and so forth. Together with the teachers, we developed an initial plan and schedule for implementing the multimedia book review project beginning early in the fall.

Phase 3. Phase 3 occurred during approximately the first 6 weeks of the school year. During that time, members of the university research team gathered baseline data including qualitative observational and interview data aimed at creating a rich description of the school and classroom environment as well as of the teachers and students. We also gathered quantitative data aimed specifically at determining the amount and diversity of students' independent reading and their attitudes toward reading. Toward that end, teachers administered the *Elementary Reading Attitude Survey* (McKenna & Kear, 1990), a standardized instrument designed to measure students' attitude toward reading in school and out of school. Teachers also administered a student questionnaire designed by the university research team to determine particularly the diversity of students' reading (see Appendix B). A parent questionnaire was also designed by the university researchers to determine parents' perceptions of students' independent reading outside of school (see Appendix C). This questionnaire was sent home with a letter signed by the principal investigator and the classroom teacher explaining the school activities that would be taking place in conjunction with the project and encouraging parents to communicate questions, concerns, and comments to us. The principal investigator also attended a fall meeting of the Parent Teacher Organization in each participating school to explain the project and answer questions. Also during Phase 3, teachers completed the *DeFord Teacher Orientation to Reading Profile* (TORP; see Deford, 1985) so that we might obtain information about teachers' views of reading and the teaching of reading.

All of these quantitative and qualitative sources of baseline data were also employed in three comparison-classroom classrooms in Collins School. These classrooms were selected because they represented similar populations of students and because the teachers in these classrooms were using an alternative, computer-based approach to enhancing students' independent reading. This approach was centered in the use of a commercial software program that automatically tested students' factual knowledge of a book they had read and awarded points based on their performance.

Teachers rewarded students in various ways based on the number of points they received.

One development during Phase 3 at Borders School is noteworthy because it clearly illustrates the differences between formative and conventional experiments. Approximately 1 month into the school year, one of the teachers participating in the project left the school to take another position. Her replacement knew little of the project when she arrived at the school to take over the class. This development would be seen as a severe threat to internal validity in a conventional experiment. However, from the perspective of a formative experiment, we saw this as a new opportunity to learn about how the project activities could accommodate the unforeseen variations that are characteristic of dynamic educational contexts and that can affect instructional interventions in schools.

Phase 4. In Phase 4, students were taught how to program in HyperCard up to the level of scripting. They were informed that the ultimate purpose for learning HyperCard was so that they could create multimedia book reviews. That is, they learned how to use all of the HyperCard tools for drawing, copying and pasting graphics, creating buttons and text fields, linking cards, and so forth. Phase 4 was carried out in Hartwig and Borders Schools but not in Collins School where a computer lab was unavailable to teach HyperCard. There were important differences between Phase 4 in Hartwig School during Year 1 and in Borders School during Year 2, and these differences reflect the formative aspects of this approach to research. In Hartwig School, students came to the computer lab once a week for instruction in HyperCard where they worked individually or in pairs at a computer. The instruction was provided by a member of the university research team, particularly one graduate student. The teachers brought their students to the lab and typically assisted students in carrying out HyperCard tasks as directed by the graduate student. Other members of the university research team along with a Chapter 1 teacher and parent volunteers who had been trained in HyperCard were also typically available to assist students.

The weekly lessons and activities for students were typically designed and modified from week to week based on an analysis of the previous week's lesson and observations of students' reactions and understandings as we proceeded to teach them HyperCard. The weekly lessons were also specifically designed to prepare students to create multimedia book reviews (e.g., examples and sample activities related to information about books). Between the weekly lessons, the Chapter 1 teacher worked with students who had been absent or who needed additional help. Phase 4 required approximately 18 weeks in Hartwig School during the first year of the project. By the end of Phase 4, all students were minimally competent in using HyperCard, as indicated by an informal assessment task requiring students to use all of the HyperCard skills they had learned. During all of the weekly lessons, observational data were recorded by a member of the university research team.

Based on our experiences and analysis of data during Year 1 at Hartwig School, the university research team developed a series of lesson plans aimed at teaching students how to

program in HyperCard.[1] These lessons were presented to the teachers involved with the project at Borders School during two 4-hr sessions during the summer (Phase 2) before the start of Year 2. Several of the teachers from Hartwig also participated in these sessions. Our intent was to discover whether teachers with relatively little background in using computers and who had no knowledge of HyperCard could be trained in a reasonable time to teach their students HyperCard with the lesson plans, materials, and activities we had developed. At Borders School, the Chapter 1 teacher presented the content of the lessons to whole classes for 1 hr a week in the school's media center using an LCD panel. She followed up this whole-group presentation on Monday with groups of 8–12 students on Tuesday through Friday. In the small groups, students reviewed the content of the lesson and completed activities on computers in the lab for approximately 40 min each. Under these conditions, students were able to master HyperCard programming in approximately 10 weeks. During Phase 4 at Borders School, teachers critiqued the effectiveness of the lesson plans in writing and made suggestions for further improvements. Members of the university research team were also collecting and analyzing observational, interview, and video data during that time.

Phase 5. In Phase 5, the book review template was finalized and students entered information about the books they were reading into the template. However, the template and its use varied across the three schools. In Collins School, the university research team created the template based on the specifications decided by students and teachers, because students were not taught how to program in HyperCard. Thus, students at Collins school were limited to the categories of information available on the template. At Hartwig School, students not only created the template themselves (with some guidance from teachers and the university researchers), but they also were able to use their HyperCard skills to go beyond the standard review template. We found that this approach had advantages but also presented problems. For example, when students created their own version of the standard template, there were frequently small variations, omissions, or programming errors in their HyperCard stacks that made the possibility of a database search problematic. At Borders School, we compromised these extremes by developing a standard working template for students while adding a button to the template that would enable them to use their HyperCard skills to enter personalized information about a book they had read.

Phase 6. Phase 6 involved compiling students' book reviews into a database and making the database available for use in a central location. A number of factors prevented us from reaching this phase during the first year in Collins and Hartwig Schools. Many of the same factors explained why we did not reach Phase 6 until the end of April in Borders School during the second year of the project. Mainly, we had underestimated the interacting logistical, pedagogical, and technological

[1] The lesson plans and related materials are available as an instructional resource from the NRRC (Reinking & Bridwell, 1996).

problems associated with teaching teachers and students HyperCard, creating workable programs, and consolidating the book reviews into the database so that they could easily be searched. Although the purpose of a formative approach is to discover necessary adaptations and adjustments, we underestimated the number and extent of these revisions. Thus, a major component of the intervention aimed at addressing the pedagogical goal was implemented only marginally during the second year of the project. However, we have data indicating that creating multimedia book reviews, even if they are not entered and searched into a database, effects changes relevant to our pedagogical goal.

Phase 7. In Phase 7, we had students, teachers, and parents complete again the written surveys administered in Phase 3. These data were gathered during the last few weeks of the school year in May and allowed us to compare any differences that may have occurred in responses on these instruments since the baseline data were collected at the beginning of the school year. Data were collected in the classrooms using the multimedia book review intervention as well as the three comparison classrooms using the computer-based point system.

Data Collection and Analysis

In this section, we present the types of data we gathered and how we gathered it. We also outline our perspectives on how we view data collection within our emerging understand... of a formative experiment. Our original and current perspectives provide a context for reporting our results in the following section.

Quantitative data were gathered during Phases 3 and 7 of the project, as described in the previous sections. Although we chose to collect these data, we do not believe that quantitative data are essential to conducting a formative experiment. We see formative experiments existing within the domain of research that Salomon (1991) has described as systemic, a descriptor that he argues transcends qualitative and quantitative paradigms (see also Eisenhart & Borko, 1993). Neither is a pre-/post-intervention comparison, as we have done, essential. The goal of formative experiments to modify instructional interventions to accomplish a pedagogical goal necessitates that they be more open ended than conventional experiments. Newman (1990) provides a basis for this open-endedness from a sociohistorical perspective of cognitive change that draws heavily on the Vygotskian concept of the *zone of proximal development* (ZPD; see also Newman, Griffin, & Cole, 1989). He sees computer technology as a means for bringing teachers' and students' interactions into the ZPD because it amplifies teachers' capability to organize the educational environment. Yet, this sociohistorical perspective leads him to reject the pedagogical goal as a static endpoint for all students. Many different endpoints are possible, some of which may transcend the original goals. Thus, the goal identified in a formative experiment implies no specific standard for measuring achievement of the pedagogical goal, and the goal can never be achieved in an absolute sense. A formative experiment is not completed when a predeter-

mental criterion has been reached but instead stops at some point because of practical constraints (*e.g.*, a school year ends).

Nonetheless, formative experiments must provide a substantiated baseline description of students and the educational environment relative to the pedagogical goal as a reference point from which progress can be gauged. Data supporting the description may be quantitative, qualitative, or both. Beyond baseline data, a formative experiment requires on-going, continuous data collection aimed at determining what factors enhance or inhibit the intervention's success in accomplishing the pedagogical goal, what the unanticipated by-products of the intervention are, and how the degree to which the intervention is being appropriated into the educational context.

Thus, in addition to the quantitative data gathered in Phases 3 and 7, qualitative data were gathered during Phases 2-6. Sources of qualitative data included (a) taped, semistructured interviews with teachers (*e.g.*, about their experiences with computers, see Appendix A); (b) log books in which teachers recorded their observations about events related to the project; (c) focus-group discussions with students; (d) observational field notes; and (e) videotapes of various events during the project. In addition, we examined students' book reviews on the computer, both qualitatively (*e.g.*, to examine the types of books they were reading) as well as quantitatively (*e.g.*, the number of books they were entering). These data were analyzed for the purpose of understanding what effects the intervention was having on the pedagogical goal and on other related aspects of the educational environment.

From the outset of this investigation, we had a conceptual understanding that formative experiments entailed collecting data continuously to guide iterative modifications of the instructional intervention in order to enhance its effectiveness in accomplishing the pedagogical goal. However, the absence of detailed models of formative experiments in the literature prevented us from knowing exactly how this might be accomplished in practice. Originally, we imagined that data collection and modifications to the intervention would proceed through well-defined cycles. In practice, we found that such distinct cycles did not occur. Instead, the relation between data collection and modification of the intervention tended to be fluid, even at times ad hoc in the sense that adaptations were based on the intuitive demands of the moment rather than a rigorous analysis of data.

In our reflection on this investigation as an example of a formative experiment, we have considered several explanations for this relation. First, we discovered early during the first year of the project that we had been too ambitious in deciding to work in two schools simultaneously. Likewise, we underestimated the complexity of implementing the intervention in two schools where the technological infrastructure necessary to support the intervention was not firmly in place. Consequently, during the first year, we were not able to engage in the level of systematic data collection and detached reflection and analysis that we had hoped to achieve. Neither were we able to implement the database activity during Year 1 and only partially in Year 2.

Another explanation was our discovery that our research activities during the experiment were formative in several different areas simultaneously. For example, we continuously made adjustments that were responses to factors in the following areas: logistical (e.g., How could we create more time in the daily schedule for students to work on the computer), methodological (e.g., Our observations of students working in the lab on one day might suggest that we needed to interview the teachers about something we observed on the following day), pedagogical (e.g., How might we adjust implementation to encourage more poor readers to create book reviews?), technological (e.g., The search speed on the database program is too slow. How can we make it run faster?), interpersonal (e.g., How can we as university researchers establish good rapport with the teachers, maintain teacher morale, take into account the needs of teachers, administrators, parents, and support personnel, etc.), and ethical (e.g., Should we adjust the way we implement the intervention based on our values or the teachers' values?). In addition, adjustments made in response to a concern in one area would frequently have implications requiring adjustments in another area. The interacting effects of adjustments in multiple areas required that we be less structured than we anticipated in our approach to conducting a formative experiment. However, at the same time this realization reinforced our belief that formative experiments deal realistically with the inherent complexities of implementing instructional interventions and researching their effects.

Taking a formative stance, we became aware of the unanticipated challenges and complexities we were encountering; we made several adjustments that affected data collection and analysis. For example, we decided to work in one school during the second year of the project, where we would also have the added benefit of our first-year experiences.

In addition, we decided to gather more in-depth data on 4 focal students in each class. These 4 focal students were identified by the teacher as being representative of students in each of the following categories based on combinations of reading ability and interest in reading independently: (a) above average in ability and in interest, (b) above average in ability but below average in interest, (c) below average in ability but above average in interest, and (d) below average in ability and interest. To insure the validity of selecting students to represent these categories, a member of the university research team who had collected baseline data in the classroom and the students' teachers from the previous school year also independently categorized students along these dimensions before being aware of the teachers' selections. There was no disagreement that each focal student fell within the categories identified. Teachers and members of the research team took steps to insure that focal students were not aware that they had been selected for special attention during data collection. For example, we observed and recorded our observations about focal students inconspicuously, and we noted their responses to specific questions that were addressed to a group of students or, when

addressed to them individually, were done so informally as opposed to a formal interview.

Our formative stance toward data collection, which led to on-going adjustments in what data we gathered and how we analyzed it, is consistent with current thinking in qualitative and ethnographic approaches to research (see LeCompte & Preissle, 1993). As is accepted practice in qualitative studies, the data deemed most useful emerged from our on-going analysis and emerging interpretive theories (Glaser & Strauss, 1967), but also from our evolving understanding of formative experiments. The concept of a formative experiment provided a broad theoretical framework for collecting and analyzing data. However, currently, formative experiments are methodologically and theoretically ill-defined. At the same time, the general concept of a formative experiment implies adaptability in collecting data (Baumann et al., 1996). Thus, theoretical frameworks for data collection and analysis were varied in response to on-going developments within the project, our emerging theories based on data collected earlier in the project, and our evolving understanding of formative experiments.

For example, we began gathering observational data in classrooms using Glaser and Strauss' (1967) "frame work of local concepts" as an approach to determining the amount and diversity of students' independent reading, which was critical to gauging progress toward the pedagogical goal of this formative experiment. Our local framework consisted of our experiential knowledge of classrooms, teachers, and students in general. This knowledge suggested that observation of the regular classrooms and the computer lab would be a logical initial choice as an approach to data collection. As we transcribed and annotated field notes, we determined that this approach created too many gaps in our understanding of students' independent reading. Thus, we expanded our data collection and analysis to include focused group discussions with teachers and students using techniques and theoretical perspectives described in Morgan (1993).

Another example illustrates how our evolving understanding of formative experiments affected our selection of theoretical frameworks for data collection and analysis. As stated previously in this section, we discovered during the project that a formative stance toward the instructional intervention applies to several distinct but interacting areas. We realized that a formative approach to classroom research and the emergence of these distinct areas were consistent with Patton's (1990) description of using qualitative research methods, specifically a process/outcomes matrix, to evaluate programs:

> The linkage between processes and outcomes is a fundamental issue in many program evaluations. An evaluation research design based on qualitative methods can be particularly appropriate where either program processes or program impacts, or both, are largely unspecified, for whatever reasons. Sometimes the reason is because outcomes are meant to be individualized, sometimes the program is simply uncertain about what the outcomes will be, and in many programs neither processes nor impacts have been carefully articulated. Under such conditions, one purpose of the

> evaluation may be to help articulate program processes, program impacts, and the linkages between the two. This task can be facilitated by constructing a process/outcomes matrix to organize the data. (p. 415)

Although we did not set out to create a process/outcomes matrix, our concept of a formative experiment guided us to look for linkages between processes and outcomes under the conditions that Patton describes. Interestingly, our efforts led us to formulate six distinct areas that could become the foundation of such a matrix (i.e., logistical, methodological, pedagogical, technological, interpersonal, and ethical). Thus, we conclude that Patton's theoretical framework for program evaluation may be a useful one for conducting formative experiments.

Results

As with any approach to research involving inductive methods over an extended period of time, it is not feasible to report in detail all of the data collected in this formative experiment. Of necessity, the data reported represent the researchers' synthesis and interpretation of events, and it may be organized and presented in various ways. We have chosen to use a format that Patton (1990) refers to as "key events," which he defines as critical incidents or major events, not necessarily presented in their order of occurrence. To present our results, we chose events that illustrate our major findings or that were pivotal in determining how the intervention was implemented to accomplish our pedagogical goal. The key events are organized into themes indicated by the headings in this section. Despite our realization that the formative adjustments during the experiment occurred in response to factors in a variety of areas as we discussed previously, we report here only those adjustments related to these key events.

In the discussion section, we will summarize and discuss the results within the framework of the questions guiding a formative experiment as presented earlier in this report. Before presenting key events, we provide baseline data concerning the amount and diversity of students' independent reading as a reference point for considering progress toward this experiment's pedagogical goal.

Baseline Data

Baseline data were gathered during Phase 1 of the experiment, which extended from about the second week of the school year and continued through mid-October. Data collection during this period focused on (a) determining the extent and diversity of students' independent reading and on (b) generating a general description of the school and classroom environments, including teachers' orientations toward instruction and the use of computers. Sources of data included the quantitative instruments described in the procedures section of this report, observational data, and focused group interviews with students and individual interviews with teachers. Because we have already briefly described the school and classroom contexts and will continue to explicate them in conjunction with presenting our results

in this report, we will focus here on data related to the amount and diversity of independent reading and to teachers' orientation toward reading.

Through our baseline observations and focused group interviews with students at each school, we determined that there was already a good deal of independent reading occurring in the classrooms with which we worked in this investigation. We frequently observed students reading during the school day; many had books in their desks; they knew where the local library was; they read at least occasionally at home; and so forth. Our observational data indicated that although there were a few students in every class who did very little, if any, independent reading, the majority of students at least occasionally engaged in independent reading. The variations between classrooms and across schools in this regard was surprisingly small. Similarly, the mean raw scores on *Elementary Reading Attitude Survey* (ERAS; McKenna & Kear, 1990) indicated that students in these classes had relatively positive attitudes about in-school and out-of-school reading (see Table 1). On that instrument, all but two of the classes (Ms. Andrews at Collins and Ms. Sievers at Borders School) had mean raw scores that fell above the 50th percentile.

An indication of students' baseline levels of independent reading outside of school from the perspective of their parents can be found in a questionnaire completed by parents before the project began. The questionnaire is included as Appendix C; a key to scoring the questionnaire is shown in Figure 11; and, the means and standard deviations for selected variables are shown in Table 2. Of the variables listed, "range of reading" (see Table 2) may be considered a broad indicator of students' levels of independent reading outside of school. The means reflect the average values across all students in each class whose parents rated them on 5-point likert scales associated with a variety of reading activities outside of school (item 9 on the questionnaire; see Appendix C). The mean values for each class range from 2.73 to 3.15 indicating moderate levels of reading outside of school, as perceived by parents, with little variation across the 9 classrooms.

Teachers' views toward teaching reading were determined in part through their responses on the TORP. Results of their responses to 5-point likert scale items are shown in Table 3, which lists means and standard deviations by individual teacher across the TORP's three orientations to teaching reading: phonics, skills, and whole language. The range of scores across all teachers and orientation scales on the TORP completed before the project began was 2.3 to 3.8 and the maximum difference among the scales for an individual teacher was 1.4. These values do not indicate strong differences in orientations to teaching reading among the teachers nor an especially strong commitment to any one of the orientations by a particular teacher. These results are consistent with our observations of and discussions with the teachers. A notable exception is Ms. Andrews who expressed a strong commitment to whole language but whose responses on the TORP were weighted more heavily toward phonics and skills.

Variable Name (Range)	Items	Scoring
1. Free Time (0–2)	1–2	0 = reading not checked 1 = reading checked 2 = reading circled
2. Reading/TV (x/y)	2–3	ratio of hours (nearest 1) reading (x) to hours viewing TV (y)
3. Reading for enjoyment (0–4)	4	0 = rarely 4 = all the time
4. Ability estimate (0–4)	6	well above = 4 well below = 0
5. Children's books (0–5)	7	none = 0 fewer than 5 = 1 more than 100 = 5
6. Range of reading (x/22)	9	sum of all responses on 1–5 scale (x) divided by 22 (scores for 3 items reversed)
7. Library card (1–2)	11	no = 1; yes = 2
8. Trips to library (0–6)	12	> 5 = 6
9. Books checked out (0–3)	13	none = 0 1 to 3 = 1 4 to 10 = 2 > 10 = 3
10. Change in reading (0–4)	19*	0 = much less 4 = much more
11. Change in interest	20*	0 = much less 4 = much more

*Items included only on postexperimental questionnaire

Figure 11. Key to variables on parent's questionnaire.

Table 1. Means (Standard Deviations) for Pre- and Post-Experimental Raw Scores on Subscales of the Elementary Reading Attitudes Survey (ERAS)

	Recreational Reading			Academic Reading			Total		
School/Teacher	pre	gain/loss[a]	post	pre	gain/loss[a]	post	pre	gain/loss[a]	post
Collins School									
Andrews (n = 25)	29.56	NA	30.32	23.08	NA	23.08	52.64	NA	53.40
	(4.97)		(4.72)	(6.27)		5.55	(10.29)		(8.89)
Brainard (n = 25)	29.76	(.76)	29.24	29.04	(7.96)***	24.04	58.80	(5.72)***	53.40
	(7.86)		(4.43)	(6.25)		(8.17)	(10.74)		(7.85)
Harris School									
Barton (n = 19)	29.00	29	29.29	26.84	3.11	29.00	55.84	3.37	57.29
	(6.62)		(4.95)	(8.80)		(4.89)	(14.17)		(9.67)
Palmer (n = 25)	29.76	(.16)	29.92	25.24	5.62**	28.96	55.00	5.46**	58.88
	(5.50)		(6.40)	(4.79)		(6.57)	(8.92)		(10.87)
Pearson (n = 20)	32.95	(2.65)*	30.60	28.05	(2.95)	31.00	59.00	5.00*	62.00
	(3.19)		(3.16)	(5.25)		(3.85)	(6.58)		(7.64)
Rankin School									
Mattis (n = 26)	27.35	(1.96)	25.65	25.96	(2.52)	23.25	52.65	(4.15)	48.88
	(7.87)		(10.07)	(7.29)		(9.25)	(14.66)		(17.32)
Stevens (n = 20)	27.60	3.15	28.15	26.96	.92	27.28	52.96	1.47	55.65
	(5.06)		(4.96)	(5.59)		(4.69)	(8.96)		(12.83)
Comparison Classes									
Teacher 1 (n = 19)	30.84	(2.06)	28.68	29.06	(8.26)***	20.72	59.56	10.60	49.16
	(4.78)		(4.62)	(5.89)		(5.06)	(9.03)		(8.17)
Teacher 2 (n = 22)	31.09	(3.73)***	27.36	27.86	(7.04)*	22.82	58.95	(6.77)***	50.18
	(4.76)		(4.92)	(7.27)		(5.86)	(12.66)		(11.25)

[a] = gain/loss

*p < .05. **p < .01. ***p < .005.

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Table 2. Means (Standard Deviations) for Selected Variables on Pre- and Post Experimental Parents' Questionnaire[a]

	FREE TIME			READING/TV			ABILITY ESTIMATE			CHILDREN'S BOOKS			RANGE OF READING		
School/Teacher	pre	gain/loss[b]	post	pre	gain/loss	post	pre	gain/loss	post	pre	gain/loss	post	pre	gain/loss	post
Collins School															
Anderson (n = 11)	1.8	.2*	.09	.45	.05	.84	2.55	.18	2.36	3.82	.09	3.91	2.45	.24	3.08
	(.80)		(.92)	(.36)		(.39)	(.93)		(.67)	(.98)		(.83)	(.68)		(.37)
Brown (n = 14)	.29	.14	.43	.31	.11	.42	1.77	.58**	2.15	3.21	.14	3.07	2.82	.11	2.93
	(.47)		(.91)	(.42)		(.55)	(.73)		(.80)	(.86)		(1.07)	(.45)		(.47)
Hartwig School															
Burton (n = 16)	.25	.31	.56	.31	.13	.44	2.43	.07	2.50	2.75	.06	2.69	2.94	(.19)	2.85
	(.45)		(.81)	(.36)		(.50)	(.76)		(.79)	(1.24)		(1.20)	(.75)		(.63)
Palmer (n = 19)	.90	.53*	.37	.92	.45*	.68	2.63	.06	2.69	3.16	.11	3.26	3.10	.25*	3.35
	(.81)		(.60)	(.56)		(1.11)	(.81)		(.79)	(1.34)		(1.33)	(.68)		(.52)
Pearson (n = 23)	.83	.18	.98	.65	.17*	.80	2.47	.05	2.42	3.14	.24	2.91	3.15	.04	3.19
	(.67)		(.94)	(.51)		(.57)	(.70)		(.61)	(1.40)		(1.28)	(.68)		(.91)
Rankin School															
Monroe (n = 15)	.21	.13	.33	.43	(.51)*	(.94)	2.53	.06	2.47	3.13	.34	3.47	2.75	.05	2.78
	(.41)		(.92)	(.82)		(2.55)	(.91)		(.83)	(.99)		(.92)	(.68)		(.94)
Sprouse (n = 14)	.54	.04	.46	.51	.06*	1.47	2.31	.23	2.54	3.23	.51*	3.74	3.09	.14	3.23
	(.79)		(.92)	(.94)		(1.37)	(1.08)		(.22)	(1.17)		(1.13)	(.72)		(.79)
Comparison Teachers															
Teacher 1 (n = 22)	.86	.09	.95	.66	.00	.66	2.71	.10	2.62	3.41	.09	3.32	2.95	.03	2.97
	(.84)		(.86)	(.75)		(.55)	(.96)		(.97)	(1.05)		(1.35)	(.79)		(.83)
Teacher 2 (n = 17)	.29	.24	.53	.18	.14	.32	2.45	.14	.32	3.00	.46	2.54	2.47	.21	2.76
	(.49)		(.79)	(.12)		(.51)	(.94)		(.79)	(1.29)		(1.13)	(.51)		.70

[a]See Appendix C for complete questionnaire and Figure 11 for explanation of variables.

[b]L = gain/loss

*$p < .05$ **$p < .01$

Table 2. (Continued) Means (Standard Deviations) for Selected Variables on Pre- and Post-Experimental Parents' Questionnaire[a]

School/Teacher(c)	pre	gain/loss[b]	post	pre	gain/loss[b]	post	pre	gain/loss[b]	post	pre	post	pre	gain/loss[b]	post
Cypress School														
Andronicus (n = 11)	1.73	.27**	2.00	1.80	.00	1.80	1.64	.18	1.27	2.46	2.55	1.82	.00	1.82
	(.47)		(.45)	(2.04)		(.92)	(.50)		(.47)	(1.04)	(1.13)	(1.08)		(1.08)
Brownell (n = 14)	1.36	.43**	1.79	1.29	.89*	2.18	1.21	.08	1.29	3.14	3.07	1.69	.08	1.77
	(.47)		(.91)	(.42)		(.75)	(.77)		(.80)	(.83)	(1.07)	(.79)		(.83)
Hemwig School														
Barbarin (n = 16)	1.56	.07	1.63	1.13	.20	1.33	1.13	.19	.94	2.44	2.38	1.93	.04*	2.37
	(.51)		(.50)	(.62)		(1.05)	(.34)		(.97)	(1.09)	(1.09)	(1.06)		(1.06)
Palmer (n = 19)	1.79	.00	1.79	2.00	.00	1.68	1.11	.00	1.11	2.68	2.58	1.58	.74*	2.32
	(.81)		(.60)	(.56)		(1.11)	(.81)		(.79)	(.86)	(1.59)	(.69)		(.92)
Pearson (n = 21)	1.68	.14	1.82	1.47	.09	1.76	1.14	.09	1.05	2.77	2.86	2.14	.05	2.19
	(.48)		(.40)	(1.80)		(1.58)	(.73)		(.81)	(.87)	(.71)	(1.12)		(.93)
Rodgers School														
Mitchell (n = 15)	1.71	.00	1.71	1.77	.62	2.38	1.29	.00	1.21	N/A	2.50	1.64	.15	1.79
	(.47)		(.47)	(1.89)		(1.70)	(.47)		(.43)	(.93)	(.65)	(1.08)		(1.05)
Sansone (n = 14)	1.85	.07	1.92	2.50	.00	2.50	1.08	.07	1.15	2.79	2.71	1.77	.23	2.00
	(.36)		(.28)	(1.09)		(1.95)	(.28)		(.96)	(1.31)	(1.27)	(1.17)		(1.16)
Comparison Teachers														
Teacher 1 (n = 22)	1.73	.18	1.91	1.57	.38	1.95	1.42	.09	1.50	2.55	2.59	1.96	.18	2.14
	(.46)		(.29)	(1.67)		(1.46)	(1.09)		(.87)	(.91)	(.96)	(1.29)		(1.15)
Teacher 2 (n = 17)	1.71	.00	1.71	2.14	.00	2.14	1.29	.19	1.14	2.00	2.14	1.14	.43	1.57
	(1.29)		(.49)	(2.41)		(1.77)	(.49)		(.96)	(.96)	(.69)	.69		.79

[a]See Appendix C for complete questionnaire and Figure 11 for explanation of variables.
[b]+ = gain/loss
*$p < .05$ **$p < .01$

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Technologies and Students' Interactions With Peers and Teachers

Analysis of our field notes and videotapes of students and teachers in the computer lab documented consistently that peer interaction was greater during times devoted to the multimedia book review activity than during times devoted to other academic activities. This finding is consistent with Dickinson's (1986) ethnographic study of collaborative writing involving computers in primary-grade classrooms. However, because formative experiments focus on how an instructional intervention contributes to the accomplishment of a pedagogical goal, we were interested in how the increased peer reaction might relate to students' reading. Further analysis revealed that increased peer interactions mediated the effect of multimedia book reviews on students' independent reading. This mediation is illustrated by the following event transcribed from tape recorded observations at Collins School:

> *February 16*
>
> I worked with Aaron, Dee, and Tyrone[1] to show them how to add audio to their basic template [on the computer]. I asked them who had a book we could use as an example. Aaron said he had *Where the Red Fern Grows* and got it from his desk. He told some of the story into the microphone and I showed how his comments could be recorded while the others observed. Dee asked Aaron if she could look at the book after we had finished.
>
> *February 23*
>
> I saw the book *Where the Red Fern Grows* on Dee's desk and asked her if she was reading it. She said that she was and that she liked it. When I asked her why she picked it to read, she said that she didn't know why and didn't seem to remember the incident with Aaron.

Similarly, Ms. Pearson at Hartwig School wrote in her log in January a comment that coincidentally refers to the same book: "Beth Rollins read 'Where the Read Fern Grows.' Most of the people in that section of the computer lab have now read that book."

As represented by these incidents, we found that contending with the technological skills necessary to create multimedia book reviews led to increased peer interactions, which often led in turn to incidental sharing of information about books, and, for some students, to more reading. This finding is important because it was not anticipated to occur in the early stages of implementing the intervention. Originally, we were interested in moving quickly through the necessary technological training so that students could enter book reviews into a database. Our prediction was that the database would provide a mechanism for students to exchange information about their reading and thus promote more interest in reading a wide variety of books. Despite the fact that we were not able to implement fully the database component as planned, we unexpectedly found evidence that learning technological skills led to incidental sharing of information about books.

[1]All students' names are pseudonyms throughout this report. The three students in this incident were focal students.

In addition, the interactions we observed during the times students were working on multimedia book reviews in the computer lab were different from their interactions with peers and with teachers in the classroom. Two related differences are illustrated in an event at Borders School. We were working with the teachers there to select some video clips to use in a presentation they were developing for a state language arts conference. Ms. Ellers selected a clip of two girls, one who performed well academically and one who performed poorly, working on their multimedia reviews in the computer lab on adjoining computers. Because the girls were clearly interacting about some aspect of entering their book reviews, this clip was chosen to illustrate student collaboration and cooperation. The audio was of poor quality and our first assumption was that the high achieving girl was assisting the low achieving girl. However, after watching the clip several times and listening carefully to the audio, Ms. Ellers, with enthusiastic surprise, pointed out that the low achieving girl was actually offering the assistance.

As illustrated by the previous event, students' interactions related to entering multimedia book reviews were more cooperative and collaborative in the computer lab. Dealing with the challenges of learning the technological skills necessary to enter multimedia book reviews seemed to generate a heightened sense of camaraderie and helpfulness among students. In the computer lab, they seemed genuinely interested in the achievements of their classmates and in the products they were developing. Discovering special effects on the computer screen or creative applications of HyperCard tools were often cause for special attention and sharing. For example, at Hartwig School, Betty, a student who had a Macintosh computer she could use at home, created a special presentation on the computer as a Valentine to Ms. Pearson, her teacher. The whole class gathered around a computer to enjoy her presentation, several students asking, "How did you do that?" Helpful interactions tended to occur spontaneously, but at Hartwig School, we (the teachers and the university researchers) tried to enhance this positive effect by asking students who questioned us about some aspect of HyperCard to consult with another student who could help them. Across all of the classrooms we observed, negative interactions occurred less frequently in the computer lab and they tended to be conflicts related to using the technology such as a dispute about whose turn it was to type at the keyboard.

Another difference illustrated by the incident on the videotape was that, in the computer lab, helpful interactions originated from the lower achieving students as often as from the higher achieving students. Students who had academic difficulties in the classroom sometimes became experts in the computer lab where they might be called upon to assist their higher achieving peers. For example, our field notes taken while observing Shawn, a focal student classified as low reading ability and interest, state,

> Shawn has been ready to assist others in reading what was on their screens in order to figure out what should be done next, and he was not at all inhibited about

> helping someone new to the class with what needed to be done.

As this example indicates, the assistance offered by students having low reading ability frequently involved reading and interpreting texts.

Interactions between teachers and students were also affected by participation in the multimedia book review activities. For example, it was clear that teachers did not define themselves as experts when presenting information related to the multimedia book review activities. Neither did students hesitate to offer their expertise to teachers. In fact, all of the teachers involved in this project seemed to enjoy the idea that many students exceeded their own technological understandings and that students were often able to teach their teachers. The following statement by Ms. Ellers' from an October meeting of the teachers and research team illustrates this viewpoint:

> . . . and they love to show me because even with the demonstration this week of the new fields, you know (*gave rapid directions on how to do fields*), well then I said you need to do that each time. Well then today, and this was the first time that I even knew it, they said 'oh you don't have to do that for a new field, you just go up to new field and automatically go over there on the tool palette.' Like wow (*laughing*). I didn't know that. But hey, they really get a kick out of that.

Likewise, Ms. Palmer at Hartwig School in a semistructured interview about her experiences with and attitudes about computers in the classroom stated, "It doesn't bother me at all to say to one of my children to tell me how you did that (on the computer)."

We did not find any evidence that the number of computers had any noticeable effect on the level of peer interactions. At Collins school where there was a single computer in each classroom, peer interactions related to the multimedia book reviews occurred over an extended period of time as small groups of students took turns using the computer during free time. At Collins and Hartwig Schools, two or three students often worked together at the computer. However, at Borders School, where students typically worked at their own computers, there was still considerable interaction among the students working in the computer lab. Students would be curious about each other's work or seek assistance, which led to considerable interaction.

The connection between increased peer interaction and incidental sharing of information about books illustrates how findings that emerge during a formative experiment can guide adjustments in implementing the intervention. For example, at Hartwig School we tried to enhance the effect of increased interactions as they related to books by pairing students to debug HyperCard stacks created by students in another class. Students completed this activity periodically using a guide sheet that we provided for them. We reasoned that in the process of debugging the programs, paired students might also interact with each other about the books being reviewed by their peers in other classes. Interestingly, we did not find that to be the case. In fact, the guide sheet tended to encourage students to take on the role

of highly critical editors who looked for surface level mistakes in spelling and punctuation. Likewise, when we purposefully used students' work from Collins School as examples to students in the Hartwig School, the Hartwig students often focused on surface level mistakes in the examples. We did find some evidence that this critical stance did enhance students' concern for the accuracy of their own work. However, because students' reviewing of each others' work seemed to distract students from activities directly related to the experiment's pedagogical goal, we did not introduce this activity at Borders School during Year 2.

Effects Related to Reading Ability

From our data, especially related to focal students, we noted that reading ability often figured prominently in determining and understanding the effects of the multimedia book review activity, although these effects were complex and often varied across classrooms. For example, Ms. Broward's class at Collins School had a disproportionately high number of readers reading well below grade level when compared to other classes in her school. She often expressed concern about students' lack of achievement and communicated her displeasure to students when she felt they were not meeting their potential. In her log, Ms. Broward noted that many of the poor readers in her class did not seem interested in entering book reviews. In a focused group interview with her students where we were seeking students' reactions to entering their books on the computer, James, one of the focal students classified as a poor reader, stated, "All I can read is easy books anyway, so why put them on the computer."

We hypothesized that some of the poor readers, in Ms. Broward's class may feel the same way, that is, perhaps they were embarrassed to enter books below grade level, thus publicizing their reading problems. We met with Ms. Broward to discuss this possibility. She agreed that it might explain the lack of interest among the poor readers, and we discussed possible solutions. Ms. Broward suggested that since we had discussed eventually making the database containing her students' reviews available for students in lower grades to find books they might like to read, it would be necessary to have easier books in the database.

This observation evolved into a relatively minor but effective formative adjustment in the way the intervention was implemented in Ms. Broward's class. Soon after our meeting, Ms. Broward announced to the class that she was concerned about the lack of multimedia book reviews of easier books. She explained that eventually some second- and third-grade students would be interested in searching the multimedia book reviews for books they might like to read. She expressed hope that some students would enter easier books for these students. Following this announcement, we noted an increase in the number of book reviews entered by poor readers. In fact, within several weeks, James had entered more books than any other student in the class. Because he tended to be a leader, at least among his poor-reading peers, his sanctioning of the activity seemed to encourage other poor readers to enter easy books too.

On the other hand, in Hartwig and Borders Schools where we taught students basic HyperCard skills, the low achieving students seemed to gain confidence and self-esteem immediately from working on the computers. For example, Robert, a focal student in special education at Hartwig school, one day presented a member of the university research team with an illustrated poster printout he had made on the computer that stated, "I love computers." Follow-up discussions with his classroom teacher and special education teacher revealed that Robert was enjoying his new status as a computer expert not only in the lab but also showing others how to use the computer for word processing in his classroom. Ms. Pearson, his teacher, wrote in her log, "When we got a word processor to use, Roger was the one who showed the rest of the class how to use it. He was proud of himself, and so was I."

There is some evidence that Roger's attitudes toward reading improved as well. His overall score on the *Elementary Reading Attitude Survey* (ERAS) increased from the 62nd percentile in September to the 70th percentile in the following May, although there was little evidence that he was reading more or more divergently as measured by the Parent's Questionnaire and the Choosing Things to Read instrument. Interestingly, his higher overall score on the ERAS was the result of a substantial increase on his score for the school reading subtest that compensated for a slight decrease in his home reading score.

Related to our finding that dealing with technological issues increased peer interactions across academic ability, we found that dealing with the more complex technological issues related to creating multimedia book reviews tended to obscure visible differences in reading ability, which were more obvious when students were engaged in other academic activities. For example, we attempted to validate independently through our observations teachers' selections of focal students who varied on reading ability and interest. It was not possible to do so by only observing students working with the computers, as indicated by these notes from our October field notes while observing in the computer lab:

> Q (to myself) What about 4 selected students? I can't tell who they might be in here . . . Q (to myself) Does anyone appear to have a problem with reading? Doesn't look like it in here.

On the other hand, it was possible to do so by observing students in the classroom, as indicated again from our October field notes: "Aide [in classroom] assisting students who are having trouble with their work. Teacher monitoring/checking students comprehension—esp. poor students." The teachers' comments and our own observations repeatedly converged to indicate that distinctions in reading ability were less noticeable in the computer lab than in the classroom.

Shane, one of the focal students classified as low ability and low interest in reading, was observed to have many difficulties reading in his classroom, but had no problems reading in the computer lab. We observed him avoiding reading and answering questions in the classroom but not in the computer lab when work-

ing on the multimedia book review activities. In an interview, Ms. Ellers stated:

> Shane . . . [was] really loving the social stuff where I would show the whole group what we would be doing on Monday. With their little group, I would show them on the overhead and they would see what we were doing that day. And he would remember it all. He was very successful when we were just creating their stacks and doing the fields and buttons and copying from Art (this *clip art available for students to use in their reviews*) and whatnot.

Lower ability students who were not especially adept at using the technology could distinguish themselves in other ways, too. For example, Ms. Burton states in Lee's log, "Even my slow ones are doing a good job. Lee and David (special ed.) have some good ideas for creating stacks. They need more help, but other students are there to help out."

The multimedia book review activities also tended to stimulate creativity among many of the high ability readers, in our estimation, more so than would be likely with conventional book reports. And, it seemed to reinforce their typically strong interest in reading. For example, Elizabeth (E), a focal student identified as having high ability and interest in reading responded to a researcher's (R) interview questions as follows:

R: Have you told anyone about this HyperCard project?

E: I've told basically friends and family.

R: What have you told them?

E: I told them all the things that we had been doing that day in the computer lab, and how I couldn't wait until the next time we go in there. It's real fun.

(discussion about the previous HyperCard lesson on audio buttons)

E: That was fun. I did mine. I did all my voice impressions. I did my Zsa Zsa Gabor impression, I did a real sophisticated lady impression, and Mrs. Morris was saying, Go on, keep going.

Likewise, in a February interview Ms. Ellers commented on the fact that Elizabeth has always been a good reader, while citing an example of how working on the multimedia book reviews provided an opportunity for recommending a book to her teacher:

> Elizabeth is a very top-notch student. She reads a lot anyway. She even brought me a book before Christmas and said you need to read this. I said I would try to read this over the holidays. She was in my third-grade classroom and we've been real close, and so she is comfortable with me. Of course she is doing well and I can see an increase in reading. She has always been a top reader.

Transcriptions of a tape-recorded April meeting of the university research team and the project teachers aimed at discussing how to increase students' sharing information about books revealed that good readers were already doing this:

R: Could we have the students to exchange book reviews . . . ?

Ms. E: They've already done that. One'll hear what another says, or they will tell me about their books—but these are the top students.

Similarly, Ms. Palmer at Hartwig School wrote in her journal, "I have found that students that I find that read consistently were the ones that had several books to put into the files after Christmas."

Increased Student Engagement

Our data collected in various ways and across various contexts contain repeated examples indicating that students were more engaged in learning and using the technology related to creating multimedia book reviews than in other academic activities in the classroom. A typical example comes from a comparison of our field notes while observing Shane in the classroom and in the computer lab:

(notes from classroom observation)

Shane [5th grade focal student—low ability/low interest] does not appear to be working at all on his math problems. . . . Shane is turned around in his seat to talk to his neighbors. . . . Shane is the first one done with his math. . . . Shane is sitting and tapping some pencils. Shane is looking at what a neighbor is drawing. . . . Shane is playing with two blue highlighters. . . . Shane gets up to check the lunch menu. . . . Teacher asks Shane about whether he has shown his work, and where his work page is. Shane answers that he has thrown away his work. Teacher says to add the work on to his paper. . . . I haven't been looking, but Shane appears to be done again (no one else is).

(notes from computer lab observation, two days later)

Shane passes out the template guide at the beginning of class. . . . All students working now; no one off task. A new students pops. Shane (in a neighboring seat) says, "What's wrong?" Antoinette says, "I don't know." Shane immediately scoots over to help her. . . .

(later that class period)

Antoinette: "You left out your 'E.'"
Shane: "Where?"

Another illustration comes from our videotapes of students working in the lab. Ms. Ellers and a member of the research team discovered that Jason, a student whom teachers considered to be hyperactive because of his extreme distractibility in the classroom, was sitting almost motionless staring at the computer screen for more than a minute working on a multimedia book review activity. Most of the obvious examples of increased attention were related to students who were poor readers. For example, in discussing a poor reader at an October meeting between the teachers and the university research team, Ms. Ellers stated,

Ms. E: I know this group of fifth graders real well. Some of them have just really excelled, 'cause I bragged on one of them in [Mrs. Morris]'s room the other day be-

> cause this child is probably reading at least two years behind grade level, but when he comes in here, he's totally tuned in to what I'm doing, and he probably cannot read. It's probably accurate to say he cannot read, you know, the pull down menus and what it says. But he is focusing exactly on what I'm doing, he's seeing where I'm dragging down to, and I mean, he's going to town on it. . . . He copied five pictures when everybody else, you know the most was two.

Beyond increased attention and involvement in tasks related to the multimedia book review activities, increased student engagement was a label that captured other categories of our observations as well. For example, many students seemed to acquire a different persona when involved with project activities, often becoming less inhibited, more verbal, and more cooperative. In an audiotaped focused group discussion with the teachers, Ms. Morris observed:

> And a lot of the ones that answer questions in the media center, like when we're doing the whole group, a lot of those that I've seen, you know they raise their hands and they wanna answer are those that you wouldn't, they're not real verbal in class as far as answering something that we've discussed. You know, they're the ones that remember that you (*several voices, unintelligible*) edit and go down to this, and what to punch to do this.

Students who were shy and reserved in the classroom seemed more willing to take risks and ask questions when involved in creating multimedia book reviews as indicated from the following reflection from our field notes.

> I find it interesting that, having watched, that they WILL ask questions. Because there are some students, and I'm sure you know it, that if they don't understand, they won't even ask questions. But in here, it seems that nobody's afraid to ask something, you know if they don't see something right. I have no idea of their abilities, because I'm not there every single day to see who's the best and who's the worst, or not even to use those terms.

The technological challenges of using HyperCard seemed to enhance students' engagement as opposed to frustrating them. As Ms. Sievers stated in a focused group meeting with teachers, ". . . I haven't seen anybody get really frustrated. They do in the classroom on other things, but not on this." In fact, students' frustration surfaced mainly if something prevented them from working on the computers. Ms. Sievers observed in the same meeting,

> [the students] just threw a fit if they didn't get to come to HyperCard. I mean, . . . we had thought it might be a little late, was it yesterday? (*looking at Ms. Ellers*) and I mean we fell to pieces on the floor in the classroom. They really got upset because they didn't think they were gonna come, and when I tried to explain, I mean they were just so [upset].

When we talked to students about their participation in the multimedia book review activities, their responses were almost always positive reflecting their motivation and engage-

went. However, their positive responses were almost always related to using the computer, particularly HyperCard, as opposed to specific comments about book reviews. Typical comments were, "It gives you a chance to do more activities and funner stuff," ". . . it's like, you can draw . . . you can pick pictures to draw and stuff. You can do your own voice and it (HyperCard) has all sorts of stuff on it," "'cause you get to draw and don't do no work . . . . (Researcher asks: HyperCard's not work?). . . . Nope." In fact, as students mastered HyperCard skills and began to focus more on entering book reviews, some of the motivation and enthusiasm waned. In a February meeting with teachers aimed at discussing formative adjustments in the way we were implementing project activities, Ms. Ellers stated,

> . . . they are coming in there quite regularly (students who have real books to put on the computer), so they're really progressing whereas some kind of get left behind. We haven't decided—as how we're going to handle getting those others to get to that state—you know, the less motivated—that's something we need to sit down and discuss . . .

At times, the lure of nonacademic games and drawing programs also overshadowed students' interest in entering book reviews. For example, Ms. Palmer at Hartwig School wrote in her journal that one of her students suggested "a nonstructured day in the lab, just to have fun . . . as a break."

Our discussions of formative adjustments to implementing the multimedia book review activities often centered on how to channel students' increased engagement related to HyperCard and the computer toward accomplishing our pedagogical goal. At times there were tradeoffs, sometimes due to technological considerations. For example, the decision to use a standard template for the book reviews to be searched in the database, decreased the need for students to exercise their HyperCard skills. We compromised by adding an open-ended section to the template where students could use their HyperCard skills to create additional individualized information about each book they reviewed. At Hartwig School, the teachers decided to insist that students enter new information about the books they were reading during the first 20 min of the weekly hour-long session in the computer lab; during the remaining time, students were free to incorporate multimedia presentations into existing book reviews if they chose to do so. However, it is important to note that we did not find any evidence that students disliked entering book reviews or that the intriguing aspects of using multimedia on the computer distracted students from reading books.

Effects Related to Particular Schools and Teachers

As expected, the specific effects of the multimedia book review activities varied among the schools and classrooms participating in the project. Working in seven classrooms in three schools with seven classroom teachers and two key adjunct teachers allowed us to

discover general effects of the intervention that cut across the different instructional contexts, but also allowed us to speculate about variations that intensified or mitigated those effects. In this section, we discuss these variations. Our findings in this area are limited by the fact that the intervention was modified when implemented during Year 2 in Borders School based on what occurred during Year 1 in Collins and Hartwig Schools. In a more general sense, any formative experiment is limited by conditions that are not amenable to adjustment in particular situations, but noting the effects of these conditions may enhance understanding of their importance in achieving the pedagogical goal.

Examples of conditions that were not easily modified in the present formative experiment include the impracticality of creating multiple versions of the software, the availability of space and equipment in a particular school, scheduling students, and so forth. Beyond such practical, technological, and logistical constraints, there are the expected differences in teaching styles, educational values, instructional approaches, and so forth that vary among teachers and schools. Even if it were possible to modify these naturally occurring differences in educational orientation, any attempts to do so are fraught with ethical problems. Thus, the differences we discuss in this section are aimed at understanding more about the effects of the present intervention, but our specific examples may also be generically useful in understanding issues researchers may face when conducting formative experiments.

We devoted considerable attention to searching our data and speculating about causes for the clear differences we observed between Collins and Hartwig Schools during Year 1. Teachers at both schools were enthusiastic about the project in the early stages, as were members of the university research team. For example, as the project began, teachers in both schools wrote enthusiastic comments in their logs indicating that they had high expectations for the project and were looking forward to their participation. During an interview early in the school year before the computer activities were introduced, teachers indicated that they thought the multimedia book review activities would "inspire students to read," "allow students to use the computer in an interesting way," and "give me [the teacher] an opportunity to learn more about the computer."

As the year progressed, however, the clear enthusiasm and morale evidenced early in the year deteriorated at Collins School but not at Hartwig School. By spring, Ms. Andrews at Collins School, who initially had greater competence and parental assistance for using computers and higher achieving students in her classroom than did her colleague Ms. Broward, had fallen far behind her, almost abandoning entirely the project activities. At Hartwig School (and later at Borders School), project activities extended into other areas of the curriculum, but this was not the case at Collins School.

Drawing on our observational and interview data, the following factors seem to be involved in explaining the difference between these two schools:

1. The professional climate of the two schools was distinctly different. For example, although principals and central office personnel were highly supportive of the project in both

schools, the administrative style in Collins School was more top-down, and administrators' interest in the project seemed related more to its value for public relations in the community and its implications for test scores than for its potential to enhance curricular goals or to further students' and teachers' development. Teachers seemed constrained, pressured, and sometimes even intimidated by this administrative stance. We conducted interviews with six teachers at Collins School early in the school year. When asked about possible negative outcomes of the project, virtually all of them expressed concern that they might not have time to work the project activities into their set schedules. For example, Ms. Andrews justified her preference for using computers in a lab setting by stating that "the lab guarantees everybody the right to 45 minutes." (Although teachers at the other schools also frequently discussed the pressures they were under to cover the established curriculum, they were willing to seek out ways to work the computer activities into their schedules and commented on how worthwhile it was to do so, and they seemed to expect cooperation from their administrators.) Additionally, toward the end of the school year, to our great discomfort, it became evident that administrators at Collins School were not honoring teachers' requests for future teaching assignments because of the new assignments' potential effect on the project. In contrast, administrators at Hartwig School seemed focused more on student and teacher development, respecting teachers' judgement in altering their schedules when necessary and encouraging them to work as an team, seeking administrative support when necessary. For example, a visit from the District Language Arts Coordinator at Hartwig School was punctuated by many comments to members of the university research team about the project's potential to promote the District's goal of moving toward a more an integrated curriculum rich in authentic reading and the goal of enhancing teachers' technological expertise. Although administrators associated with Collins School occasionally referred to similar goals, they more often mentioned how the project would promote the school's reputation such as achieving a state-wide designation as a school of excellence.

2. The Collins teachers perceived that they were not getting as much attention from the university research team as were the Hartwig teachers. Furthermore, they perceived that when compared to the Hartwig teachers they were at a disadvantage because they only had one computer in their classroom instead of a computer lab. The event that clearly initiated these perceptions was a joint presentation involving teachers from both schools at a national conference. During the presentation, Collins teachers saw that they had not accomplished as much as the Hartwig teachers, and from that point seemed dissatisfied with their own situation as evidenced by frequent references to Hartwig's superior resources during our subsequent interactions with them. To a certain degree their perceptions were accurate. The research team did spend more time at Hartwig because more time was necessary to teach students how to use HyperCard, whereas we delivered more finished products to Collins. The substantially greater distance to Collins

School also limited the number of visits by the university research team. As the year progressed, we found it increasingly necessary to give teachers at Collins encouragement that we were not disappointed with their progress, yet this encouragement became less convincing to the teachers, and importantly to ourselves too as the year progressed. Nonetheless, we believe the differences in morale are due more to the teachers' perceptions than differences in resources or support. Neither are we convinced that the multimedia book review activity faces insurmountable problems in a classroom with only a single computer.

3. Teachers at Collins School seemed to be more conscious of whether the research was being conducted properly and whether the activities were successfully meeting our goals. We explained the concept of a formative experiment to teachers at both schools early in the project emphasizing that we did not expect the project activities to succeed uniformly in every context or without formative adjustments based on our data collection. Regardless of the school, teachers on the whole did not often seem comfortable with pointing out difficulties with project activities or with suggesting ideas for improvement with members of the university research team, to whom they often deferred. For example, during January, Ms. Pearson at Hartwig School wrote in her journal:

> I had my interview with Dr. R today. I was very relieved to find that they [the university research team] were pleased with our progress. A lot of apprehension was relieved.

However, the Collins teachers seemed to be more concerned about how the data were being collected, whether we thought the project was being successful in our eyes, and whether we approved of their involvement. Their concern and doubt may have reflected their decreasing morale and likewise exacerbated it. Consequently, the Collins teachers seemed to rely heavily on our direction and support. Ideas for extending the project were discussed with enthusiasm but were not often implemented without direct support and followup from the university research team.

4. Although teachers in both schools expressed that they felt pressured to cover curriculum, Ms. Andrews and Ms. Broward at Collins School were under greater stress from other sources than were the teachers at Hartwig School. In addition to greater administrative pressures to conform and achieve, both of their families experienced serious medical problems during the school year. In addition, at Collins we did not observe a strong sense of teamwork and mutual support among the teachers at the school. Ms. Andrews and Ms. Broward originally volunteered to become involved in the project because they had developed an affinity based on their interest in whole language, openness to new ideas, and desire to learn more about technology. Throughout the project they clearly collaborated well on project activities under the direction of the university research team, but they did not fully integrate their efforts, at least to the extent we observed at Hartwig School. There was little sharing of expertise and resources that proceeded from joint problem solving. In our interviews and informal interactions with other teachers at the

school, we often heard of criticisms, jealousies, and disagreements between and among teachers, some of which extended to incidents or situations outside of school in the community. In addition, there was noticeable turmoil in Collins School precipitated by the fact that the principal was running for election as school superintendent, there was uncertainty about who would be her successor as principal when she was elected in November, and which teachers would be assigned to a new school that was to be opened the following year. Collins School was also preparing for an extensive remodeling that disrupted activities, especially during the last month of the school year.

5. The fact that the project activities were carried out with a computer in the classroom at Collins as compared to a computer lab in the other schools may have been a factor that figured in the differences we observed. Schedules had to be arranged to use the computer labs, thus there needed to be a fixed time in the teachers' schedules for engaging in book review activities, and that time had to be coordinated with the other teachers involved in the project. Having the flexibility to work the activities into one's schedule on an on-going basis, as was the case at Collins, may have led to fewer collaborations between the teachers and the temptation to forego the activities when they felt pressures to complete mandated instruction. Additionally, students at Collins seemed less enthused during group presentations, perhaps because these presentations occurred in their classroom as opposed to making a special trip outside the classroom to the computer lab. For example, in our field notes recorded during a presentation about how to use the computer, we observed the following: "... there were several students who were not paying much attention ... it was snack time and some of them were exchanging potato chips with each other and others were preoccupied with an art project." In contrast, our notes observing in the computer labs suggested that students were highly attentive to presentations unless distracted by their desire to work on the computer.

Another difference between Collins School and the other two schools relates to variations among teachers and their roles in implementing the intervention. The effects of the multimedia book review activity were clearly influenced by the characteristics of individual teachers working together with their colleagues and the research team on the project, although the effects of teacher variations and school variations clearly interact. All of the teachers who participated in the project were enthusiastic about their participation at the outset, and none had more than minimal acquaintance with using computers personally and in the classroom prior to this project as evidenced by their responses to a structured interview (see Appendix A). However as the project proceeded, we found that teachers tended to fulfill several identifiable roles. To a certain degree, teachers shifted roles throughout the project, although they tended to gravitate toward one role. Each of the following roles seem salient in understanding the effects of the multimedia book review activity and how it might be effectively implemented[6]:

[6]Our categories might be compared to those suggested by Hadley and Sheingold (1993).

The technology expert. A teacher at each of the three schools acquired this role early in the project by virtue of her greater interest and quicker success in mastering the hardware and software, accompanied by a greater commitment to work on the computer beyond the minimal requirements for the project. We conducted training sessions for all of the teachers prior to the beginning of the school year and the role of technology expert emerged at that time. The other teachers not only acknowledged this role (e.g., comments such as "Ms. Ellers will help us do that."), but they seemed to need the technology expert to sustain their own efforts (e.g., "I know I couldn't have done that without Ms. Burton's help."), sometimes in a way that seemed to prevent them from extending their own technological expertise (e.g., "I couldn't do this next year myself, but maybe I could with Ms. Burton's and Ms. Pace's help."). The negative effects implied by this latter comment indicating dependency can be seen by Ms. Andrews progressive abdication of the role of technology expert at Collins School. As Ms. Andrews became less involved in the project activities, Ms. Brownd was forced to deal more with the technology herself and by the end of the school year had increased her expertise beyond Ms. Andrews. On the other hand, it was the teacher in the role of technology expert at each school who was instrumental in extending the project activities into other areas of the curriculum or other school activities, and this served as a model and resource for the other teachers. For example, Ms. Burton, who became a technology expert at Hartwig School, used her new HyperCard skills to create a tutorial directing students how to create a display for the school science fair. Likewise, Ms. Pace, a Chapter 1 teacher assisting the teachers at Hartwig, quickly became a technology expert helping students with make-up activities and debugging their work.

The emerging or marginal technology expert. Another role was characterized by teachers whose early involvement in the project activities was enthusiastic but passive, deferring almost entirely to members of the research team and to the teacher(s) in the role of technology expert. Gradually, however, teachers in this category seemed to become more comfortable using the technology and more enthusiastic about the intervention's effects. Ms. Pearson's involvement during the project at Hartwig School is illustrative. Transcriptions of our tape recorded field notes early in the school year state,

> [Ms. Pearson] sat at the table away from the computers in the lab today counting money and filling out book orders. She seemed to put us [members of the university research team] in charge with no intention of participating in learning how to use the HyperCard stacks or of working with students.

As the year progressed, however, Ms. Pearson's involvement increased greatly as she became more comfortable with the technology and saw the enthusiastic response of her students. Later in the year, on her own, she decided to extend the multimedia book review activity into her social studies unit on the Civil War. After all of her students had read a novel set at the time of the Civil War, she divided

her students into groups to develop a multimedia presentation on some aspect of the book, including a class videotape in which students in costume acted out various episodes in the book. As the year progressed, Ms. Pearson became more actively involved in the activities in the lab by offering help to students or letting them teach her skills. Ms. Pearson did not seem to define herself as a technology expert, but did move far in that direction over the year. This growth is apparent from our field notes at the end of the school year:

> I told [Ms. Pearson] that next year we would be moving on to another school and that Hartwig teachers would be one their own. Of all the teachers at the beginning of the year, she is the one I thought would be most concerned with that. I thought it was significant that now she didn't seem that concerned. She kind of made a little face when I told her, but it wasn't at all a negative reaction . . . . more like "I'm not sure" but maybe I can.

Another example, was Ms. Morris at Borders School who in a teasing manner chastised us for not observing the day that she took over for Ms. Ellers and taught her students a lesson on using HyperCard.

The facilitator. Some teachers, at least for a time, seemed to assume the role of a facilitator; that is, a teacher who is not especially intrigued with the technology, which was in the domain of the technology experts, but who is interested in discovering and enhancing the nontechnological effects of the program. For example, Ms. Pearson's movement toward technology seemed to originate with her attempts to facilitate the positive effects she was seeing on her students in the classroom. Ms. Sievers at Borders School also could be classified as a facilitator because she did not indicate more than passing interest in the computer, but she attempted to connect classroom reading and writing activities with students' multimedia book review activities in the computer lab. Likewise, teachers who focused on identifying and solving practical and logistical problems were assuming the role of facilitator.

The passive participant. Teachers in this role may be enthusiastic about the project and its potential benefits, but they rely primarily on others (their fellow teachers or members of the research team) for explicit direction and guidance. Their personal investment in the project is low in terms of independent effort to engage in creative problem solving to address logistical, practical, technological, and pedagogical problems. They do not contemplate possibilities for extending or adapting the multimedia book review activities or coordinating them with other curricular areas; or, if they do, such extensions must not create too much of a disruption to their current instructional routines. There is little evidence among teachers assuming this role of attempts to master the computer outside of school hours including formal training sessions led by the members of the university research team after school. They have a relatively low tolerance for dealing with developments that prevent the activity from meeting their expectations of success. This role tended to be assumed more often by the teachers in Collins School, especially as the project progressed. However, we wish to emphasize that this is not a generalization that extends to other

instructional activities in their classrooms, nor, does it do justice to their more laudatory teaching practices. Additionally, we believe that the professional climate of their school and district may have predisposed them to assume this role, as did their declining morale explained previously in this section.

The Effects of the Project on the Educational Environment

Our interest in the effects of the project on the educational environment was motivated by Newman's (1990) explication of formative experiments. He states,

> Whatever the pedagogical theory motivating the experiment, the outcome to be observed must include how the environment becomes organized differently as it appropriates the technology and other resources. . . . If the environment, rather than the technology, is the unit of analysis, changes in the instructional interactions, changes in teacher roles, and other ways that the educational environment is changed are observed. (p. 10)

We found that teachers' involvement with project activities was somewhat paradoxical. Often they tended to view multimedia book reviews and their potential benefits in relation to conventional academic activities and skills. At the same time, particularly at Hartwig and Borders Schools, teachers were willing to give up time devoted to teaching conventional activities and skills so that students had time to work on the book review activities. In the teachers' views, the multimedia book review activities seemed embedded within a conventional schema for what students ought to be doing and learning in school, while simultaneously they engaged enthusiastically in an activity that to some extent subverted that schema. Teachers' concerns that students acquire particular skills and be held accountable for their work co-existed with their enthusiasm for activities that were clearly addressing less tangible goals (such as increasing students' self-direction, confidence, creativity, and ability to master the technology). This dual focus can be seen in Ms. Burton's log where she states,

> I felt they needed to see a stack in progress to understand more about what is required. I want them to be creative! . . . Once they got into creating their own cards, the creative juices began to flow. [*And one page later*] I am having students record pages read each week and having parents sign.

On one hand, teachers tended to see the project activities in conventional terms. For example, despite the research teams' explanations that we preferred the term "book reviews" instead of "book reports" (because of the negative connotations of book reports) and despite our consistent use of this terminology, the teachers almost always referred to what students were doing as "multimedia book reports" or "book reports on the computer." As described more fully in a subsequent section, teachers were especially enthusiastic about how the project activities were benefiting the technical aspects of students' writing. Additionally, they seemed more satisfied than did

members of the research team with conventional responses to books such as writing summaries as long as they were technically correct. For example, teachers were often reluctant to provide the research team with disks containing students' work until they had been proofread and corrected, often by one of the teachers. In her log, Ms. Pearson stated, "They are not proficient writers. Their writing skills are very poor. They refuse to use dictionaries to check their spelling. I am embarrassed to let some of them take their work to the computer lab." Some of the teachers sent home reports of students' progress on the book review activity to parents and they were concerned that students not enter certain kinds of reading material such as magazine articles or joke books on the computer. We see these findings as consistent with previous research (e.g., Bruce & Rubin, 1993) indicating that teachers tend to conceptualize and use innovative activities involving technology in a way that conforms to conventional academic values and experiences regardless of the activities' potential to transform standard practice.

On the other hand, we saw some evidence that teachers' enthusiasm for the benefits of the project led them to forego, displace, or extend more conventional activities in their classrooms. For example, although the teachers at Hartwig and Borders Schools often emphasized the many expectations placed upon them for covering content and becoming involved in special activities such as essay contests, they rarely opted out of the project activities even though we invited them to do so if necessary. In addition, teachers in both of these schools created their own plans for catching up students who had missed a lab activity.

As the year progressed, at Hartwig School especially, we saw evidence that the teachers were appropriating computers and the book review activity into their teaching beyond the specific project activities. Contrary to the beginning of the year when computers in the classrooms were used almost exclusively for drill and practice or game programs for students who had completed their work, the classroom computers began to be used for other purposes. Ms. Burton, who initially acquired the role of technology expert at Hartwig, used her new HyperCard skills to develop a tutorial directing students how to prepare their science fair displays. In our field notes we also observed that,

> [Ms. Pearson] was excited to show me that the students were working on a word processing station in her classroom. . . . She also told me that she had ordered a word processing program on the Apple [computer]. Apparently she did not have a word processing program in the classroom before. I think this may be an indication that she is starting to use the computer more in her classroom.

Later in the year, one of us noted that, "I thought it was very significant that [Ms. Pearson] told me in passing that she skips spelling to do word processing in her classroom."

From the standpoint of the project's pedagogical goal, the most notable example of how the project activities could extend and transform conventional instruction occurred in Ms.

Pearson's class. In February, Ms. Pearson decided to break students into groups to create a class review on the computer of a book she had decided to have students read in conjunction with a social studies unit on the Civil War. She wrote in her log,

> Today I gave all of my students a copy of *Shades of Gray*. They are going to do a book report on the computer. They were very excited and immediately began to read. I am going to let them group together to do different parts of the book report. They are going to make the decisions on the way the book report should be done. Almost everyone uses any spare moment to read this book.

Along with the computer-based activities designed by each group, the students with minimal teacher direction and support produced a video of episodes from the book. Students got involved in all aspects of the production including elaborate costumes and staging and according to Ms. Pearson, "They were willing to give up breaks to organize the video." The multimedia book review project clearly led the teacher to conceive of this activity and for the students to carry it out with enthusiasm while becoming involved in a positive experience related to their reading. The activity also led students to explore independently aspects of books that they would have unlikely encountered prior to the intervention. For example, as Ms. Pearson states in her log,

> One group talked about the author and her personal life. They did research and discovered that the author was a Civil War history buff. She had actually visited and studied the Shanandoah Valley where the story takes place.

Through this activity Ms. Pearson's students also participated in a more in-depth response to a book than they would have in writing a conventional book review. For example, she wrote in her log that one of the groups involved in this class project dealt with "problems of main character—How (problems) they were dealt with/book/how same problem should be dealt with by us if were faced with same challenges."

As the project progressed, teachers also noticed connections between classroom activities and students' work on the multimedia book reviews in the computer lab. At an October meeting, Ms. Ellers remarked,

> Well, these things that [John, a member of the university research team offering technological assistance] observed the other day though. . . . [W]hen after I show them what to do, I tend to go over here to my right and work with this group. And this group back here—there's about three students. Well, they created their fields, but they started just typing a story in the fields. You know, they did their own little thing. So, you know, and he [John] said, "Well, where do you think they got that from?" And I said, "Well, they do a lot of creative writing in [Ms. Sievers'] class. So that has some [carry over from one situation to another]". . . .

Nonetheless, the general enthusiasm for and commitment to the project activities among

both teachers and students tended to balance, sometimes precipitously, on its relation to conventional instruction. Teachers often expressed the benefits of the project in terms of conventional instructional goals while enjoying its less academically oriented effects, occasionally linking the two as when we pointedly asked the Borders teachers in a meeting: "Does the need to make the book review presentable—understandable—play any role in dampening students' enthusiasm?" Both answered "no" loudly in unison. Students too were affected by this balance. If the multimedia book review activities began to take on the characteristics of conventional classroom activities, enthusiasm waned. For example, in a February interview Ms. Ellers observed,

> But several of the fifth graders when they come in here into the classroom [lab], they're ready. They *just* need to plug in the information. That's one biggie I would say. The fifth grade really likes doing it. I hear a lot of positive comments from them, from certain groups of them, because there are several that don't come in there as much anymore because they know that is the requirement now: if they don't have their book review ready or written it, then they're not ready to go to the lab. They're going to miss their time whereas if someone else is ready that can go in their place since they now [each] have their own individual disk. And so some of them are in there two, three, or sometimes even four times a week. They are coming in there quite regularly, so they're really progressing; whereas some kind of get left behind. We haven't decided on how we're going to handle getting those others to get to that state—you know, the less motivated—that's something we need to sit down and discuss . . .

Technology, particularly as manifested in learning and using HyperCard, seemed to play a pivotal role in tilting the balance away from conventional instruction. As documented previously in this report, teachers were less inclined to see themselves as experts in the computer lab, often deferring to students' expertise. In addition, students' and teachers' work on HyperCard involved highly engaging and interesting activities in a nonthreatening academic environment that was separate from the classroom where participants carried out most of their daily routine. Students who had academic problems in the classroom frequently excelled in using the technology, and students' increased interactions with their peers and with their teachers were frequently supportive and positive. The cumulative effect of these characteristics seemed to override teachers' concerns associated with conventional instruction. However, entering information about books, as a more conventional activity, seemed to remind participants of more academic concerns, which in turn evoked more conventional reactions.

As the emphasis on learning and using HyperCard decreased, concerns related to conventional academic goals and achievement increased, thus perhaps negating some of the potential influence of the multimedia book review activity. At Hartwig School this effect was mitigated by the fact that the intervention clearly extended into other classroom reading and writing activities and indeed into other

areas of the curriculum. At Collins School, where students were not systematically taught HyperCard and where students completed project activities in their classroom, the technology remained firmly entrenched within the context of conventional classroom activities. This too, may account for the relative lack of involvement by teachers and students at Collins. We see Borders School as representing a middle ground where interest in technology was high, which sustained the activity much of the year, but where there was no clear evidence that the intervention was influencing instructional activities beyond the specific book review activities. Consequently, some students seemed to lose interest in the book review activity later in the school year.

Comparing our experiences within and among schools, we hypothesize that the initial contribution of the intervention toward accomplishing the pedagogical goal is based on how involvement with technology, particularly learning HyperCard in a computer lab, establishes a positive context that clearly transcends conventional academic activities, concerns, demands, responses, and so forth. Multimedia book reviews are associated positively with this environment and contribute to the pedagogical goal as mediated by factors such as increased interaction. Gradually, however, as emphasis shifts away from learning and using the technology toward completing book reviews, a more conventional mindset emerges. Teachers begin to associate the project's benefits with conventional academic skills such as writing skills and conventional practices such as requiring minimal amounts of reading. However, these effects are mitigated when teachers more fully appropriate computers into their classroom teaching and extend the multimedia book review activities into other areas of the curriculum. These effects might also be mitigated by moving quickly to the database phase of the intervention, although this is speculative since we were not able to implement fully this feature. In fact, the delay in implementing the database may have contributed greatly to the shift toward a more conventional perspective of the activity among some of the teachers.

Quantitative data from the TORP completed by the teachers at the beginning and again and the end of the school year are relevant to these issues. Pre- and posexperimental means and standard deviations on the TORP are shown by teacher in Table 3. Two statistically significant changes in orientation to teaching were noted. Ms. Burton at Hartwig School became less oriented toward whole language as can be seen by comparing her means on that subscale at the beginning and the end of the school year. Ms. Ellers at Borders School became less oriented toward phonics as can be seen by comparing her means on that subscale at the beginning and the end of the school year. These data do not provide any clear evidence that the intervention changed teachers orientation toward teaching reading. Ms. Ellers' move away from phonics may have been associated with the university course work she was taking as part of a degree program. Ms. Burton's move away from whole language may have been due to the stress on skills associated with end-of-year testing. However, we have no

Table 3. Means (Standard Deviations) for Teachers' Pre- and Postexperimental Scores on Subscales of the TORP

	Subscales					
	Phonics (10 items)		Skills (10 items)		Whole Language (10 items)	
School/Teacher	pre	post	pre	post	pre	post
Collins School						
Andrews	3.0[a] (1.08)	3.0 (1.02)	3.8 (.84)	4.1 (.90)	2.4 (.71)	2.3 (.75)
Barnard	2.0 (.66)	2.0 (.81)	2.9 (.91)	2.3 (.80)	2.4 (.81)	1.8 (.75)
Harding School						
Burton	2.9 (1.14)	2.0 (1.00)	2.5 (.95)	2.5 (.88)	3.0 (.90)	2.5* (.62)
Palmer	2.9 (1.30)	3.0 (1.11)	2.3 (.90)	2.4 (.85)	2.6 (.68)	2.4 (.54)
Pearson	3.0 (.40)	2.9 (.40)	2.9 (.75)	2.6 (.87)	3.6 (.63)	3.2 (.72)
Sanders School						
Ellers[c]	3.2 (.80)	2.5* (.60)	2.4 (.58)	2.3 (.62)	2.5 (.63)	2.6 (.70)
Sievers	N.A.[b]	3.1 (.66)	N.A.	2.4 (.62)	N.A.	3.9 (1.05)
Means	2.6 (.72)	2.5 (.64)	3.1 (.54)	3.1 (.66)	2.7 (1.12)	2.8 (1.30)

[a]Means are based on a 5-point Likert scale where 1 = strong agreement; lower values indicate stronger orientation.

[b]Pretest scores not available for Ms. Sievers because she replaced original teacher after baseline data were collected.

[c]Though Sievers took over Ellers' class, Ellers was the teacher most directly involved in working with all students in the computer lab with each teacher.

*$p < .05$.

supporting evidence from our qualitative data to clearly link the two statistically significant changes to the multimedia book review activities.

Changes in the Amount and Diversity of Students' Reading

The pedagogical goal of this formative experiment was to increase the amount and diversity of students' independent reading. Before presenting our findings concerning the effects of the intervention on students' independent reading, we discuss three factors that limited our ability to collect data aimed at determining whether the intervention was accomplishing that goal.

First limitation: The Hawthorne effect. It was difficult to separate a Hawthorne effect from other effects due to specific aspects of the intervention. From the outset, all of the stakeholders in each of the three schools expressed unmitigated enthusiasm for the project, and they were clearly excited by the facts that their schools had been selected to participate in a project supported by a major federal grant. In addition, these schools, like many other schools in our experience, had a high commitment to integrating technology into instruction and they were seeking guidance to accomplish that goal. This commitment was heightened by a statewide initiative to infuse technology into schools backed by substantial new funding from the state lottery earnings.

School and central office administrators were clearly interested in capitalizing on the public relations value of the project as evidenced by the facts that articles about the project appeared in local papers, the project was highlighted in applications for a state-wide "school of excellence" award, and members of the university research team were invited to make presentations about the project at meetings of the parent-teacher organization and the local school board. Parents expressed their support for the project in terms of their belief that a familiarity with technology was important to their children, and students were excited about being able to use the computers. The effects of this general enthusiasm and support can be seen in the following transcript of tape recorded reactions one of us dictated after attending a meeting of the Parent Teacher Organization early in the school year: "Several parents commented to me how supportive they were of the project being at the school. One father said that his son had brought a book home in anticipation of the beginning of the project." Also, teachers, perhaps because of the high enthusiasm and expectations, suggested that they were apprehensive about the project's success. One of the teachers recorded in her log: "I had my interview with Dr. [member of the university research team] today. I was very relieved to find that they [research team] were pleased with our progress. A lot of my apprehension was relieved."

The enthusiasm, high expectations, and apprehension created by the project clearly had potential to affect the pedagogical goal. In fact, as discussed earlier in this report, we believe these factors figure prominently in explaining the decline of morale at Collins School. However, other considerations place the limitation implied by the Hawthorne effect in perspective. First, we did collect data in several con-

tool classrooms that were using a computer program designed to promote independent reading by awarding points when students demonstrated adequate knowledge of a book's content. In addition, the project acquired a lower profile as the year progressed and teachers became more accustomed to the idea of a formative experiment in which the intervention could be adapted in response to negative outcomes or problems. The fact that we worked in the participating schools for an entire school year also mitigates over time against the Hawthorne effect. Lastly, we believe that the Hawthorne effect is to some degree inextricably linked to interventions involving computer technology in schools, at least currently. That is, given the present interest in using technology in schools and the relative novelty and unconventionality of computer-based activities, the Hawthorne effect is not just a nuisance variable but one that merits study in its own right as a factor that may influence the effectiveness of computer-based interventions.

Second limitation. Detecting subtle changes in students' independent reading. From the outset of this project, we believed that the effects of multimedia book reviews on students' independent reading were likely to be less direct and less immediate than other interventions such as providing extrinsic rewards for the number of books read. However, our pedagogical theory values more highly those activities designed to develop long-term, intrinsic motivation to read as included in what Alvermann and Guthrie (1993) describe as the engagement perspective. Given that the intervention proceeded from this perspective, we expected changes in students' independent reading to be subtle and to emerge over an extended time. Likewise, we expected that detecting such changes and connecting them unequivocally to the intervention would be difficult. Not only was it difficult to connect the intervention to observed movement toward the pedagogical goal, it was also difficult to determine specific aspects of the intervention's implementation that enhanced or inhibited progress toward the goal.

To address this limitation, we collected a variety of quantitative and qualitative data aimed at determining the amount and diversity of students' independent reading throughout the school year. Quantitative data included having students complete the baseline and postexperimental ERAS (McKenna & Kear, 1990) and a questionnaire concerning the diversity of their independent reading. Additionally, parents completed a questionnaire concerning students' reading outside of school. These data are reported in Table 2. Qualitative data included observational field notes, semistructured and focused group interviews with teachers and students, videotapes, and teachers' logs. Nonetheless, our difficulties in collecting data were evident in the following excerpt from our field notes.

> I worried that I was just not seeing what I was "supposed" to be seeing. I saw the good readers sneaking books to read under their desks and relying on themselves or close friends for book suggestions. I don't know that with the time I spent in the classroom that I would ever see the students diversify their own reading or increase it. I was simply not there all the time, and I was

not their teacher. If I taught these students every day, I would see what was in their bookbags, I would hear their stories, I would see their interactions in the classrooms, I would see what is done with their free or extra moments. The short time segments that I spent in the classrooms just didn't let me see what needed to be seen.

Consequently, we tried to make our classroom visits at times we thought students would have some free time to read. We also relied heavily on teachers' comments during interviews and in their logs to monitor the effects of the project on students' independent reading.

Third limitation: Baseline levels of independent reading. As noted in the section reporting baseline data, the majority of the students involved in this project already engaged in a good deal of independent reading and had positive attitudes about in-school and out-of-school reading. Under such conditions it is less likely that we would be able to determine whether the multimedia book review activity was increasing independent reading than if there were many students who did little independent reading. Determining the effects of the intervention on independent reading was further complicated by the documented finding that independent reading tends to decrease as students advance through school (see Foertsch, 1992; McKenna, Kear, & Ellsworth, 1995). From this point of view, maintaining students' level of independent reading over an extended period of time can be seen as movement in a positive direction relative to this trend. Indeed, this phenomenon enters into our subsequent presentation and interpretation of the ERAS data.

Findings from the quantitative data. Quantitative data were obtained from (a) the ERAS (McKenna & Kear, 1990), (b) a questionnaire designed to measure the diversity of students' reading, (c) a questionnaire designed to measure parents' perceptions of students' reading outside of school, and (d) the *Defford Theoretical Orientation to Reading Profile* (TORP; DeFord, 1985). Students completed the ERAS and the diversity questionnaire; their parents completed the parent's questionnaire; and, teachers completed the TORP. Participants completed these instruments during the first month of the school year prior to beginning the intervention and again during the last few weeks before the end of the school year. Tables 1–4 show pre- and postexperimental results including the gain or loss by various categories. Also shown, are those pre- to post-experimental differences that are statistically significant when compared using a *t*-test for correlated samples.

The results of the ERAS shown in Table 1 indicate that for the intervention classes, statistically significant gains in mean raw scores were evident in one class on the recreational reading subscale, in two classes on the academic reading subscale, and three classes on the total across both subscales. In the two comparison classes where a computer program was used to award points for reading books, statistically significant decreases in raw scores were evident in one of the classes on the recreational reading subscale and in both classes on the academic subscale and on the total scores across both subscales. Changes in scores on the

Table 4. Means (Standard Deviations) for Students' Scores on the "Choosing Things to Read" Questionnaire

	Time of Administration		
School/Teacher	Fall	Spring	Gain/Loss[a]
Collins School			
Andrews	56.00	53.64	(2.36)
	(12.84)	(12.16)	
Broward	61.61	49.83	(11.78)*
	(13.09)	(11.05)	
Hartwig School			
Barton	52.55	44.45	(8.09)*
	(14.45)	(14.88)	
Palmer	31.27	44.91	13.64**
	(11.88)	(10.68)	
Pearson	54.35	51.39	(2.96)
	(17.49)	(17.57)	
Borders School			
Morris	52.51	56.00	3.79
	(13.40)	(18.45)	
Stevens	47.33	53.81	6.48
	(14.45)	(16.41)	
Comparison Classes			
Teacher 1	51.25	52.00	.75
	(11.51)	(13.86)	
Teacher 2	58.00	46.68	(11.32)
	(12.47)	(9.27)	

[a] = gain(loss)
*$p < .05$. **$p < .001$.

ERAS from the beginning to the end of the school year must be interpreted in light of the tendency of elementary school students' raw scores to decrease over time (Foertsch, 1992; McKenna et al., 1995). For example, a raw score of 52 on the ERAS results in percentiles of 35, 42, and 49 for fourth-, fifth-, and sixth-grade students, respectively. These data suggest that students attitudes toward academic and recreational reading tend to increase (or at least not to decrease at expected levels) more in the classes involved in the multimedia book review activities than in two classes using an alternative computer-based activity aimed at increasing independent reading.

Means and standard deviations by class for the "Choosing Things to Read" questionnaire

are shown in Table 4 (see Appendix B for the complete questionnaire). Pre- and postexperimental means for four classes involved in the intervention decreased, two of which were statistically significant, and means for three classes increased, one of which was statistically significant. The mean for one of the comparison classes increased and one decreased, neither of which was statistically significant. These data do not clearly support or contradict an assertion that the intervention had any effect on the diversity of children's reading across schools.

Means and standard deviations by class on selected variables from the Parents' questionnaire are shown in Table 2 (see Appendix C for the complete questionnaire and Figure 11 for an explanation of each variable). Among the seven classes involved in creating multimedia book reviews, statistically significant gains on variables included on the parents' questionnaire were as follows: free time reading (1 class); ratio of time spent watching TV and reading (2 classes); number of children's books in the home (1 class); range of reading materials (1 class); number of trips to the library (1 class); possession of a library card (1 class); and reading for enjoyment at home (2 classes). None of the decreases in means were statistically significant. Among the seven classes involved in the study over 2 years, one class had 4 statistically significant increases (Ms. Palmer at Hartwig), two classes had 2 statistically significant increases (Ms. Broward at Collins School and Ms. Sievers at Borders School), three classes had 1 statistically significant increase (Ms. Andrews at Collins School, Ms. Burton at Hartwig, and Ms. Morris at Borders School). No statistically significant increases or decreases on the variables identified in the Parents' questionnaire were observed in Ms. Pearson's class at Hartwig School or in either of the comparison classes. However, the statistical significance of these findings must be interpreted in light of the many comparisons conducted across classrooms and variables.

Findings from qualitative data. Teachers and parents clearly observed increases in some students' independent reading, which they connected to the project activities. Their comments in interviews, audiotaped and videotaped meetings, project logs, and off-hand comments recorded in our field notes, consistently refer to positive changes in students' independent reading, which was manifested in various ways.

Our data contain frequent reports of changes in individual student's reading as reported by parents and teachers. For example, our field notes from Hartwig school include the following notation:

> I was talking [with a parent who helped in the lab] and she said she didn't know if it was due to his project, but she had noticed a very significant, noticeable improvement . . . in her daughter's reading at home. She had said that her daughter has many books at home before and would occasionally read parts of them but would never seem to finish them . . . whereas now she observed her daughter doing much more reading, finishing the books and talking more about them. . . .

Likewise, Ms. Pearson recorded the following in her log:

> Several parents told me throughout the year how pleased they were that we were involved in this research project. They said their children had always had plenty of books at home, but they never seemed to completely read their books. They (the parents) were able to see drastic changes in their children throughout the year. Their children were now completely reading books and asking for more. The parents were very excited about the changes.

And, on another occasion she wrote again in her log:

> I tutor a third grader. One afternoon when I took him home from tutoring, his mother wanted to know if we would be doing the research project with the computers when [her younger son] got to 5th grade. She wanted us to because Karen, her daughter in Ms. Palmer's class, had greatly benefited from this year's project. She said that Karen was reading at home all the time. She also said that Karen's writing skills had greatly improved this year due to using computers to do book reports.

Ms. Burton wrote in her log in February:

> Today I noticed that Candace had a collection of books on her desk. I asked her if she was reading now and did she enjoy it. She showed enthusiasm about reading and told me about her books. I asked her if she felt the computer book reports had aided her in choosing to read and she said she liked putting her work on the computer.

During a visit to observe in Ms. Broward's class at Collins School, she pointed out that Mitch, a poor reader, was unexpectedly bringing abridged classics to school to read. We discovered that he was asking his mother to buy these books when he accompanied her to the supermarket. He was anxious to show us his new book each week and explained that he wanted to get them to enter into the computer.

Some of the teachers observed positive changes across all of the students in their classes, which they attributed to the project activities. For example, Ms. Burton wrote in her log, "I saw a lot of growth in my class in many ways. Toward the end of school, I saw kids through with work reading books. I saw them completing work in order to read their book." As discussed in a previous section, other teachers observed that the effects were more obvious with readers of high or low ability. For example, Ms. Pearson noted in an interview that she thought the project "encourages students to read, especially those with lower reading abilities. . . ." Ms. Ellers, on the other hand, saw more of an effect on the better readers as evidenced from her response when we asked her what she saw happening relative to the pedagogical goal: "With the top readers, yes, this [project] is a hit. With the high ability/high interest readers it amplifies that effect."

Teachers frequently observed connections between project activities and classroom events that they perceived as positive changes related

to the amount of children's reading. For example, Ms. Pearson stated in a videotaped interview,

> Today, two low-average readers turned in Troll book orders. What impressed me most was that these 2 students ordered Troll [book club] at home for the summer. It is now February. In 13 years of teaching 5th grade, I have never had any students to order Troll at home even closer to the summer time.

Ms. Palmer recorded in her journal: "I'm noticing more students are asking for additional pages to record books." Ms. Sievers at Borders School related the following incident during an interview:

> I know we finished reading the book *Summer of the Monkeys* and I was real surprised—last week I guess it was, one of the students, Paul, came up to me and asked if he could borrow it. It was one that was real special to me. I didn't know what he was going to do with it at that time. I said why are you going to borrow it when we've already read it, and he said he was going to do HyperCard, do it on the book report, so he took it with him. Then the next day—the next time when he came back and asked me if he *could* borrow it again and he could not find it, he got very disturbed that he couldn't find it. So he said maybe Andy had apparently gotten it to go and do his book report on it also. It is a thick book—a fairly hard book just to read by yourself. But that is something that Andy, not being a good reader—for him to take the initiative and either do it on his own or have someone tell him that he could do it on that one. To actually take the time to get it and go and do it—it was a real surprise; a pleasing surprise.

The qualitative data that we gathered provides little evidence of an increase in the diversity of students' independent reading, at least in terms of books. Teachers rarely made comments related to diversity in their logs or brought up this aspect of the pedagogical goal. In fact, when asked directly about the diversity of students' reading, the teachers indicated that they were not seeing any positive or negative changes. For example, Ms. Ellers responded as follows:

> Now as far as diversity, I'm not seeing a whole lot of diversity because they're [into] series books and you know some little girls like the Sweet Valley Twins or whatever . . . they're coming in here with a notebook or sheets of papers, so *amount* I've seen more, but not *diversity*.

In the same discussion, Ms. Sievers agreed, adding "I'm seeing not much diversity also (either). They kind of read the same things: fourth-grade books, chapter books."

Nonetheless, teachers occasionally saw changes that might have indirect effects on diversity. For example, Ms. Palmer commented in her log that as a result of the project, students were beginning to realize "that this [activity] was not about book size (number of pages)—but to read whatever interests them and use this reading to relate or pass on to other students their opinions of various literature." We also observed that focal students read diverse materials. For example, we re-

corded the following in our field notes: "Elizabeth (hi ability/hi interest) was observed having different paperback books in her desk on three occasions." Likewise, when we received permission to look at what books were in students' desks and when we observed them during free reading times during February, we saw evidence that many individual students were reading diverse materials such as nonfiction, fantasy, and football souvenir programs. However, this diversity did not seem to be connected directly to the multimedia book reviews or influenced greatly by this activity. Effects in this area seemed to be indirect at best, as proposed in a previous section discussing how dealing with some of the technological components of the activity had secondary effects on the amount and diversity of students' reading.

Several possible explanations may account for this finding. First, teachers seemed to relate more directly to the goal of increasing independent reading than to increasing diversity. This orientation may have subtlety affected the way they implemented or reinforced project activities and/or selectively influenced their perceptions. Also, the project activities focused on books, not other reading materials such as magazines, which may have given an overly narrow view of students' reading. Likewise, because the database activity was not fully implemented, students did not participate for an extended period of time in a part of the project with greater potential to increase diversity.

Students' Increased Concern for Writing

Although the teachers were aware that we were most interested in their observations pertaining to the pedagogical goal of increasing independent reading, they were also encouraged to note other effects of the project activities. In this regard, they often focused on the benefits of the program in helping students become more proficient in the technical aspects of writing and of editing. Students increased attention to technical aspects of their writing were not only quite visible but also seemed to be especially noteworthy in teachers' explanations for the value of the activity. In their logs, teachers repeatedly made comments such as the following.

- . . . it seems the kids are being more careful about word usage, spelling, and punctuation.
- It is interesting to watch how much easier the kids are catching mistakes (spelling & usage) of each other. There is a lot of revising going on when these kids pair up to create their stacks.
- Their essays [in a writing contest entered by all of the fifth-grade students] were much improved over prior students. We feel like this project has helped students' writing skills as well as reading skills.
- We are working in [the lab] reviewing one another's work—editing, etc. Amazing how students can see mistakes of other students and not recognize their own.
- I *do* feel that our students' exposure in computer program helped them to be better editors.
- . . . this experience has made them [students] aware of the writing/proof reading/editing process.

Clearly, the involvement in creating multimedia book reviews had an effect on students' writing as we also noted independently in our field notes in comments such as the following:

> I've noticed . . . that students are much more careful with their writing. They ask how to spell words when writing. [Ms. Burton] notice too that students working in the lab are more concerned about their spelling. [She felt that] students feel some ownership over their book reviews.

This increased care in writing seemed related to students viewing the multimedia book reviews as public documents intended for use by teachers, parents, the university research team, and other students. Jason, one of the focal students at Hartwig school, stated, "I have to fix that [spelling error] because I don't want anybody to think I'm dumb." Students also seemed to gain satisfaction from finding errors in spelling, grammar, and punctuation on those occasions when they read each others' reviews. Their attention to others' work may have increased attention to their own, perhaps to avoid criticism from their peers. Teachers also emphasized technical correctness in students' reviews, which may have heightened students' concern for technical correctness. Several of the teachers insisted that students write out a technically correct version of the text of their reviews before they were allowed to enter it on the computer. However, for the most part they did so in an off-hand, informal way rather than badgering students about their writing.

Miscellaneous Preliminary Findings and Unanticipated Effects

We report here several preliminary findings and observations that may be of interest to those who wish to conduct related formative experiments. These preliminary findings were not central to our stated pedagogical goal nor to our interest in determining the degree to which computer-based activities were fully appropriated by teachers and students. Neither are these findings based on extensive, systematic data collection and analysis.

1. Typing was not a major obstacle for students in this activity. Although none of the students had highly developed typing skills, they were content to type slowly when entering textual information. Students virtually never complained about having to type information, despite that it was a laborious task for most of them. Moreover, students working in pairs at a computer were usually content to wait on their partners when typing information.

2. Participation in this project had a notable effect on teachers' professional development that extended beyond the project. Although this project did not have all of the marks of a true collaborative research project between classroom teachers and university researchers (see Allen et al., 1992; Anders, 1996; Jervis et al., 1996), teachers seemed to benefit professionally from their involvement in the project. All of the teachers presented at least once at a professional conference (to our knowledge, none had done so before); one teacher began an advanced degree program in conjunction with the project while

another incorporated it into an on-going program. Most notably, three teachers submitted proposals to a state conference on their own in the year following the completion of the project. Several of the teachers noted in their logs that these activities were somewhat intimidating but at the same time rewarding and professionally meaningful.

3. Parental involvement in the classroom and school increased in Collins and Hartwig Schools where a concerted attempt was made to recruit and train parents to assist with the HyperCard programming. Increased parental involvement was also a by-product of the video created by Ms. Pearson's class because parents were enlisted to make costumes, find props, and donate video equipment. Even in Borders School where parents were not recruited to assist with the day-to-day multimedia book review activities, many parents attended a school technology fair where the multimedia book review project was among the displays. Many parents seem to have an inherent interest in technology on behalf of their children and enthusiastically support such efforts. Their involvement seemed to be valued equally by teachers, administrators, and students, although for reasons that are likely to be somewhat different for each group. Parents seemed to react positively to participating in learning about technology in a nonthreatening way with teachers and their children. Our experience in this project fits well within and reinforces the model for creating a community of learners through the implementation of computers as proposed by Keeler and Alexander (1994).

4. The project clearly increased the ability of teachers and students to use the computer effectively. They learned specific skills related to HyperCard such as being able to create buttons and to link cards, which can be transferred to other applications. They also learned general information about hardware and software such as how to hook up and use an LCD panel or how to move files from a disk to the hard drive. Also as a result of their participation in the project, they learned how texts might be incorporated with other media to create electronic documents. Long-term experiences with such activities have demonstrated that students change their conceptions of writing and reading (see Tierney et al., 1992).

Discussion

The primary purpose of the present study was to investigate how a multimedia book review activity might be implemented in middle-grade classrooms to effect increases in the amount and diversity of students' independent reading. That purpose was derived from our interest in an approach to classroom research that Newman (1990) has described as a formative experiment. Formative experiments address a domain of questions and issues that are particularly relevant to the use of computer technology in schools and that have not been addressed by conventional experiments, nor typically by qualitative approaches to research. A secondary purpose was to expand and to refine our knowledge about the concept of a formative experiment as a an approach to classroom research and about the practicality of conducting such research. In this section, we discuss each of these purposes separately.

Discussion of Results

Both the quantitative and qualitative data indicate that the multimedia book review activity contributed to achieving the pedagogical goal of increasing the amount of children's reading. Although, as one might expect to discover using a formative experiment, the manner in which the activity contributed to the pedagogical goal was not necessarily anticipated at the outset of the project. The intervention's effect on achieving the pedagogical goal was clearly mediated by students' and teachers' responses to the challenges of working with the technology, particularly HyperCard, not primarily by the creation of multimedia book reviews and sharing them with others as anticipated. The introduction of the multimedia book review activities represented a novel intrusion into normal classroom routines, which was greeted with much enthusiasm by teachers and students as well as administrators and parents. That climate combined with a change in the social dynamics of instruction and the increased engagement of students and teachers led to increased interactions about and enthusiasm for books, which in turn led to more independent reading. Thus, the increase in independent ready was more a by-product of students' and teachers' primary focus on mastering the technology, particularly HyperCard. This conclusion is reflected in the following transcription from one of our tape-recorded field notes at Hartwig School during February:

> [Ms. Pearson's comment] leads me to think that maybe some of the effects of the project are indirect in the sense that teachers' involvement with the project are leading them to emphasize independent reading more which filters down to the students so that some of the effects we're seeing maybe during the project are not directly due to the students entering book reviews but the total impact that the project is having on the school or the teachers such that independent reading is emphasized more.

Put another way, our pedagogical goal of increasing the amount of independent reading was furthered more by connecting books to an engaging, challenging use of the computer than by the capability of the technology to encourage sharing of information about books. This realization gradually led us to see our investment of considerable time and effort into having teachers and students learn HyperCard not has a frustrating distraction from our intended goal but as an important way to enhance it. Thus, in the project's second year, we felt justified in refining the activities designed for teachers to learn HyperCard who would then teach it to students.

We believe this finding to be important because it could be argued that the intrigue of the technology would be so distracting as to work against the pedagogical goal, which would call into question the utility of the entire activity for accomplishing the identified goal. Also, we believe the fact that involvement with technology tended to mediate the accomplishment of a valued pedagogical goal is consistent with the perception of many educators that technology can be valued intrinsically for that purpose. It is not trivial to determine that technology can act as a catalyst for changing

the typical interaction patterns among teachers and students. Such changes are the basis for arguments that technology offers strong potential for bringing about school reform (see Means, 1994). Thus, the results of this study have implications that extend beyond the particular pedagogical goal and the instructional intervention investigated. Not only may the use of technology in schools positively alter social interaction patterns in schools, it may further curricular goals in various subject areas by embedding relevant content within challenging and engaging computer-based tasks such as using HyperCard. In that regard, the findings of the current investigation are consistent with other studies indicating that challenging uses of technology can over time further the goals of literacy instruction in schools (e.g., Tierney et al., 1992; Turner & Dipinto, 1992).

On the other hand, we found that the extent to which the technology was fully appropriated by teachers was decidedly mixed. Factors that seem to account for differences include the role that teachers assumed in relation to the activities, the logistical arrangements that were necessary to carry out the activities, and the degree to which the overall climate of a school and classroom led teachers to be flexible and independent. Although there was considerable variation from classroom to classroom, we found that teachers readily accommodated the multimedia book review activities into their instructional program, but the level of integration into their teaching beyond the project activities tended to be minimal and superficial, especially in the early stages of the project. For example, in the early stages of the project, integration rarely extended beyond occasionally rescheduling previously-planned activities to work extra time on multimedia book review activities. As the year progressed in several of the classrooms, there was some evidence that project activities were being extended and integrated into other classroom activities, most notably in Ms. Pearson's class with increased word processing activities and her implementation of the group book review activity related to her social studies unit. This minimal extension and integration coupled with the teachers' connection of the project activities with conventional curricular goals (e.g., technical aspects of writing) are consistent with much previous research findings on the effects of introducing technology into classrooms (see Bruce & Rubin, 1993; Miller & Olson, 1994). It is also consistent with a defining attribute of formative experiments as described by Newman (1990) who argues that many endpoints are possible in a particular experiment and that "[t]he environment may transcend its initial goals. It may also retain goals and organization in spite of the technology designer's concerted efforts to support alternative models" (p. 10).

Thus, although computer-based activities such as the one in this study seem to have strong potential to alter positively the social dynamics between teachers and students, this effect in itself does not seem to be adequate to transcend teachers' commitment to conventional instructional goals and activities. It seems to us, however, that teachers may be much more receptive to transforming their instruction within the context created

by a computer-based activity that points in that direction, although the data in this investigation only support that connection indirectly. One development that does support such an interpretation is that the project activities continued to be implemented in varying degrees at Hartwig and Borders Schools into a subsequent school year despite the fact that the project had concluded in both schools.

We found little evidence that the activity, as implemented, had an effect on the goal of increasing the diversity of students' independent reading. One explanation for the lack of results in this area is that we did not fully implement the database activity, which was designed specifically to expand students' awareness of a variety of books being read by their classmates. Another factor may be that teachers seemed less conscious of and concerned about this goal. It is also possible that the multimedia book review activity may not be adequate in itself to overcome students' propensity to read a narrow range of topics, genres, and authors. Broadening students reading may depend upon coordinating and supplementing the multimedia book review activity with other classroom activities in the areas such as literature response, thematic units, and reading diverse texts aloud to students.

Not surprisingly, we found that the school environments and teachers' roles to some extent shaped the effects of the multimedia book review activity. For example, the positive effects of the project seemed enhanced by a supportive, nonthreatening school environment in which teachers felt supported and trusted to make their own decisions and had the freedom to deviate from set schedules and established curriculum. The availability of equipment such as an LCD panel for group presentations changed considerably not only the options for implementing the activities but the type of social interactions that occurred during the activities. Given our experience, we are convinced that it would be difficult, if not impossible, to carry out the multimedia book review project without at least one teacher who assumed the role of "technology expert" as discussed in the results section of this report. These differences had to be taken into account as we assisted teachers who were to implement the project in each school, and which led to variations within the overall framework of the multimedia book review activity. However, when using a formative experiment as an approach to classroom research, these differences become opportunities to extend understanding of the relation between the intervention and the pedagogical goal.

Through the use of a formative experiment, we were also attuned to unanticipated outcomes of the intervention not directly related to our pedagogical goal but that might provide the basis of further study. That is, it is possible that the same or a similar intervention might be studied in relation to other pedagogical goals. For example, the multimedia book review activity as carried out in this investigation seemed to have an effect on students' writing and on teachers' perceptions of their writing. Likewise, other outcomes that might be investigated include increased parental involvement, increases in computer skills and uses, attitudes toward computers, and teachers' professional development.

Discussion of the Present Investigation as a Formative Experiment

The concept of a formative experiment guided this investigation. To our knowledge, the explication of what a formative experiment is and how it might be conducted is limited to (a) a single article by Newman (1990) who proposed the concept and provided a single example of a study from his own work, and (b) our own speculations about its utility as a form of classroom research and about a framework for designing and conducting such research (see Reinking & Pickle, 1993; Baumann et al., 1996). Thus, it seems warranted that we comment briefly here on how our experience in using this approach compared to our abstract musings about its potential merit.

Our most poignant discovery is that the formative cycle of data collection and resulting adjustments to the intervention must be considered fluid as opposed to a discreet and orderly progression of events. An advantage of approaching classroom research from the standpoint of a formative experiment is that the effects of instructional interventions are acknowledged to be the product of a complex array of interacting variables within the school and classroom environment. We believed at the outset of our investigation that through the application of rigorous research methods, we could isolate these variables and their role in enhancing or inhibiting the intervention's effectiveness toward accomplishing the pedagogical goal. Moreover, we thought that when a single variable was identified, the intervention could be modified at a definite point in time in response to it. We discovered that the multiple levels on which formative adjustments needed to be made almost on a daily basis did not permit the detached reflection and carefully reasoned decisions that we had hoped. Retrospectively, we do think, however, that future formative experiments might consider developing and using a process/product matrix that Patton (1990) has proposed as useful in evaluating programs. General components of that matrix might include concerns in the following areas: logistical (in terms of implementing the intervention), methodological (i.e., modes of data collection), pedagogical, technological, interpersonal, and ethical. Such a matrix may not eliminate the need for more fluid decision making, but may aid in documenting more clearly the relationship between variables and adjustments that were made in response to them.

Another issue we were able to address in our exploration of using a formative experiment was how to write a report of our investigation. We found that it was possible to use the conventional structure reporting a quantitative study to be suitable for reporting our formative experiment. That is, we began with a rationale for our investigation, including a literature review. However, unlike the introduction to a typical research report, we also included our pedagogical goal, the pedagogical theory that justified it, and a description of the instructional intervention we believed addressed our goal. The remainder of the report followed convention closely with sections pertaining to method, results, and a discussion of findings. Although we are not convinced that this is the best or only reasonable way to report formative

experiments, to us it seems advantageous that a familiar structure works.

The concept of a formative experiment needs more careful scrutiny and thought before it can be clearly articulated as a genre of classroom research. If it is to be widely accepted and used, it will need not only a coherent rationale, but also general guidelines for conceptualizing investigations; for planning their implementation; for gathering, analyzing, and interpreting data; and for reporting results. It will need a well-articulated epistemological rationale as well. We suspect that such a rationale may be found within pragmatic points of view as expressed by writers such as Cherryholmes (1993).

Despite the need for more elaboration and examples of formative experiments, we believe through our experience that they have strong potential as a useful, systematic alternative to existing approaches to classroom research. Among the advantages of formative experiments is that they more readily acknowledge and address the inherent complexities of classrooms while seeking ways to address that complexity toward the attainment of well-defined pedagogical goals. As such, they reflect, albeit more systematically, the often trial-and-error aspects of good teaching. This similarity to teaching may increase the receptiveness of classroom teachers to the research enterprise and to defining themselves as an integral part of that enterprise as teacher/researchers. This perspective may also appeal to educational policy makers and parents who can relate to the fact that formative experiments involve clear-cut pedagogical goals while at the same time impressing upon them that rarely are there unqualified instructional recommendations that can assure the accomplishments of those goals. Nonetheless, formative experiments do not exclude the possibility of generalizations. Factors affecting movement toward the pedagogical goal may be found to cut across different even distinctly different environments that could lead to general recommendations.

In the end, we agree with Eisenhart and Borko (1993) that useful classroom research must transcend any particular paradigm and that researchers need to be creative and eclectic in their approach to investigating teaching and learning in schools. Based on our experience, we think that formative experiments have strong potential as a framework for providing such flexibility and eclecticism while conforming to the principles they propose should guide any form of classroom research. In that regard, we believe formative experiments merit attention by a broad spectrum of classroom researchers, not just those interested in technology. Thus, we hope that this investigation will generate interest not only in our findings relative to using multimedia book reviews to enhance the amount and diversity of independent reading, but also in the concept of a formative experiment as a form of classroom research.

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Appendix A

Semistructured Interview with Teachers Before Project Began

Experience With and Attitudes About Computers

Structured Interview With Project Teachers

1. What was your experience with computers prior to this point? (Outside of school/in school)
   - Do you own a computer?
   - Would you buy one if you had the resources?
   - What would you use the computer for?
2. What were your attitudes toward computers prior to this project? What are your attitudes toward computers at this point in time?
3. Have you had any opportunities to observe students using computers? If so, could you describe the situations in which you have observed them? What were some of your observations?
   - What do you think are the students' view of computers?
4. How do you think other teachers in general view computers? The teachers in your school? Administrators? Parents?
5. What positive outcomes do you hope for in this project? What negative outcomes are you concerned with?
6. Imagine you are in a school that has as many computers as there are teachers. If you were responsible for making the decision about whether the computers would all be put in a lab or one in each classroom what would you do?
7. Can you remember when you first thought about the possibility of using a computer for teaching? Describe what you remember.
8. Has the computer affected your teaching in any way?

Appendix B

Questionnaire on Diversity of Reading Completed by Students Before the Project Began and at the End of the School Year

CHOOSING THINGS TO READ

Name _____

Teacher _____

Date _____

Part One

Directions Suppose that your teacher says you must choose a book to read from the library. Which kinds of books might you choose to take home to read? Check any kind of book you might want to read. But, don't check any you probably wouldn't want to read.

____ a book about how to play a sport
____ a story that is a mystery
____ a story about a pet
____ a book about cars or trucks
____ a science fiction story
____ a story about Indians
____ a story about kids my own age
____ a book of fairy tales or myths
____ a book on science experiments
____ a book about animals
____ a book about planes
____ a book about dinosaurs
____ a book of science experiments
____ a book about how to cook something
____ a book about trains
____ a story about strange creatures
____ a story about an adventure
____ a book about how to take care of animals
____ a book about an event in history
____ a make-believe story
____ an encyclopedia
____ a book about a person in history
____ a book about a movie or TV star
____ a book of beautiful poems
____ a story about people in other countries
____ a story about scary things
____ a story about a horse
____ a story that makes me laugh
____ a book of jokes
____ a book of funny rhymes and riddles
____ a book of cartoons
____ a story about someone in a war
____ a story that takes place in the future
____ a book about volcanoes

____ a story about someone my age
____ a book with maps
____ a story about faraway places
____ a story about monsters or strange creatures
____ a book about things that are strange but true
____ a story about boys and girls getting along
____ a story about someone who likes to play sports
____ a book about what I would like to be when I grow up

What are some other kinds of books that you like to read?

What are your favorite kinds of books?

Part Two

When you pick a book to read, what do you think about?

Directions: Answer each question by putting an X in one of the boxes.

1. When you pick a book, how often do you think about how the cover of the book looks?

never	once in a while	often	always

2. When you pick a book, how often do you think about how many pictures the book has?

never	once in a while	often	always

3. When you pick a book, how often do you think about how long the book is?

never	once in a while	often	always

4. When you pick a book, how often do you think about what your friends say about the book?

never	once in a while	often	always

5. When you pick a book, how often do you think about what your teacher says about the book?

never	once in a while	often	always

6. When you pick a book, how often do you think about who the author of the book is?

never	once in a while	often	always

7. When you pick a book, how often do you think about whether you will like the characters or not?

never	once in a while	often	always

8. When you pick a book, how often do you think about whether you will learn something from the book?

never	once in a while	often	always

Part Three

Directions Answer each question by putting an **X** in one of the boxes.

1. When you read on your own, how often do you read books?

never	once in a while	often	always

2. When you read on your own, how often do you read magazines?

never	once in a while	often	always

3. When you read on your own, how often do you read newspapers?

never	once in a while	often	always

4. When you read on your own, how often do you look for information in books like an encyclopedia, dictionary, atlas?

never	once in a while	often	always

5. When you read on your own, how often do you read stories that have characters made up by the author?

never	once in a while	often	always

6. When you read on your own, how often do you read books that give information?

never	once in a while	often	always

7. When your read on your own, how often do you read about how to do something?

never	once in a while	often	always

8. When you read on your own, how often do you read about people who really lived and things that really happened?

never	once in a while	often	always

9. When you read on your own, how often do you read books that are funny?

never	once in a while	often	always

10. When you read on your own, how often do you not finish a book?

never	once in a while	often	always

11. When you read on your own, how often do you read poetry?

never	once in a while	often	always

12. When you read on your own, how often do you read about sports?

never	once in a while	often	always

13. When you read on your own, how often do you read about animals?

never	once in a while	often	always

14. When you read on your own, how often do you read about science?

never	once in a while	often	always

15. When you read on your own, how often do you read about adventure?

never	once in a while	often	always

16. When you read on your own, how often do you read stories that are make believe?

never	once in a while	often	always

Appendix C

Parent Questionnaire
Completed Before Project Began and at the End of the School Year

Parent Questionnaire

We appreciate your cooperation in taking 10–15 minutes to complete this questionnaire, which should be returned to your child's teacher. This information is important to participation in the special computer project. If you have your child deliver the completed questionnaire to her/his teacher, you may want to seal it in the attached envelope. Thank you for your assistance.

Your child's name: _____

1. Of the following activities, check the three that your child is most likely to do during free time at home.

___ play outside
___ work on arts and crafts
___ read a book or magazine
___ work on a hobby
___ play a musical instrument
___ dramatic or pretend play (skits, playing house outerspace, etc.)
___ talk on the telephone
___ listen to music
___ play video games
___ watch TV
___ play with toys
___ other (describe) _____
_____
_____

2. Circle the activity in number one that your child does most during free time.

3. On average, how long does your child spend reading for enjoyment each day?
___ hours ___ minutes

4. On average, how long does your child spend watching TV each day?
___ hours ___ minutes

5. Of the following statements, check the *one* that best applies to your child.

___ My child rarely, if ever, reads anything for enjoyment.
___ My child reads for enjoyment once in a while.
___ My child reads regularly for enjoyment but not a lot compared to other activities.
___ My child reads regularly and often for enjoyment.
___ My child reads for enjoyment almost all the time he/she has an opportunity to do so.

6. How would you rate your child's reading ability? *(Check one.)*

___ Well above average
___ Above average
___ Average
___ Below average
___ Well below average
___ I'm not sure

7. Are there children's books in your home for your child to read? ___ yes ___ no
If so, about how many? *(Circle one.)*

fewer than 5 5–20 20–50 50–100 more than 100

8. Does your child use a computer at home? ___ yes ___ no
If yes, what kind?

9. Rate on a five-point scale how often your child does the following? *(Circle a number for each statement.)*

	Never				Very Often
Order books from book clubs.	1	2	3	4	5
Look at books/magazines in stores.	1	2	3	4	5
Ask for books/magazines as gifts.	1	2	3	4	5
Complain about having to read a book for school.	1	2	3	4	5
Bring home something from school to read for enjoyment.	1	2	3	4	5
Talk about something he/she has read.	1	2	3	4	5

	Never				Very Often
Ask to go to the library to find something to read	1	2	3	4	5
Look up information in the dictionary or encyclopedia	1	2	3	4	5
Read something to you	1	2	3	4	5
Read something in the newspaper	1	2	3	4	5
Give someone reading material as a gift	1	2	3	4	5
Read to another child	1	2	3	4	5
Say he/she doesn't like reading	1	2	3	4	5
Recognize or talk about a particular author	1	2	3	4	5
Go to movies or watch TV programs about books he/she reads	1	2	3	4	5
Write her his own "books" or stories for enjoyment	1	2	3	4	5
Read about places he/she will visit/is visiting on a trip	1	2	3	4	5
Say that reading is boring	1	2	3	4	5
Read cereal boxes or other materials while eating	1	2	3	4	5
Read in front of the TV	1	2	3	4	5
Choose Halloween costumes based on book characters	1	2	3	4	5
Use their own money to buy a book	1	2	3	4	5

10. Have you observed other behaviors (positive or negative, like the ones above) that indicate how much your child reads and how he/she feels about reading? If so, please describe them. *(Use the back of this questionnaire, if necessary.)*

11. Does your child have a library card? ___ yes ___ no

12. About how many times a month does your child go to the library? *(Circle one.)*

0 1 2 3 4 5 more than 5

13. If your child went to the library, about how many books would you expect her/him to check out?

0 1-3 4-10 more than 10

14. How much does each of these statements sound like your child? *(Circle a number.)*

a. He/she always reads the same kind of reading material on the same topic (for example, just comic books about the same character or just books about horses).

Not at all like my child	1	2	3	4	5	Very much like my child

b. He/she reads one type of reading material (for example, just books or just newspapers), but reads about a variety of topics.

Not at all like my child	1	2	3	4	5	Very much like my child

c. He/she reads many types of reading materials (for example, books, magazines, newspapers, encyclopedias, etc.), but reads mostly on one topic.

Not at all like my child	1	2	3	4	5	Very much like my child

d. He/she reads many types of reading materials on many different topics.

Not at all like my child	1	2	3	4	5	Very much like my child

15. Do you subscribe to any magazines for children? ___ yes ___ no
If so, how many? (*Circle one.*)

1 2 3 more than 3

16. Most of the adults that my child knows outside of school (*Check one.*)

___ hardly ever read for enjoyment.
___ read once in a while for enjoyment.
___ read often for enjoyment.
___ read very often for enjoyment.
___ I don't know.

17. Most of the children that my child plays with outside of school (*Check one.*)

___ hardly ever read for enjoyment.
___ read once in a while for enjoyment.
___ read often for enjoyment.
___ read very often for enjoyment.
___ I don't know.

*18. During the past school year, how often has your child talked about using the computer for reading at school? (*Check one.*)

___ never
___ often
___ occasionally
___ almost everyday

*19. During the past school year, how has your child's out-of-school reading changed? (*Check one.*)

___ reading much less than before
___ reading a little less than before
___ reading about the same amount as before
___ reading a little more than before
___ reading a lot more than before

*20. During the past year, how has your child's interest in reading changed? (Check one.)

___ much less interested in reading
___ a little less interested in reading
___ about the same interest in reading
___ a little more interested in reading
___ much more interested in reading

*21. Comment, if you wish, on your child's reading, use of the computer, and so forth. We are especially interested if you believe you have seen any connection between reading activities on the computer at school and reading-related activities outside of school.

*These items were on the end-of-year survey only.

NRRC National Reading Research Center

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